THE AUSTRALIAN NAVAL ARCHITECT

Volume 19 Number 4
November 2015

Early morning at ASC in Adelaide. NUSHIP *Hobart* (alongside), the first of the RAN's air-warfare destroyers, is now about 88% complete. Her combat system will be powered-up shortly and she will begin sea trials next year. The second AWD, *Brisbane*, can be seen under the crane in the background
(Photo courtesy AWD Alliance)

THE AUSTRALIAN NAVAL ARCHITECT

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Cover Photo:

HMAS *Canberra* off the north Queensland coast in August with five MRH 90 aircraft on deck and her four Landing Craft deployed (RAN photograph)

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The Editor
The Australian Naval Architect
c/o RINA
PO Box No. 462
Jamison Centre, ACT 2614
AUSTRALIA
email: jcjeremy@ozemail.com.au

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Editor in Chief: John Jeremy AM
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RINA Australian Division
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From the Division President

There are many areas in which naval architects work, although many of us specialise in such major areas as commercial shipping, recreational craft, naval vessels and offshore oil and gas.

Commercial shipping has been on the agenda of the Australian Division Council for a long time and we have been involved in many of its aspects, particularly in providing practical advice to legislators and assisting with the formulation of government policy (such as the USL Code and the NSCV). This year the Division Council has been monitoring and commenting on proposed changes to the Single National Jurisdiction and on the legislation for accreditation of surveyors. We would like to do more, but volunteers willing to put in the necessary hours to coordinate the work are always hard to find.

Many of our members work in the naval arena and the Division has been particularly busy over the past two months in responding to an invitation to make a submission to the Senate Inquiry into the current workforce levels and skills amongst members of the engineering profession who are employed by the Department of Defence or in defence-related businesses. Details are provided in the Secretary's column of this edition of *The ANA*. We have also been invited to appear before the Senate Inquiry on 17 November to make a verbal presentation and to respond to questions.

Much to my satisfaction, the offshore oil and gas industry has been employing many of our members, particularly in Western Australia. The WA Section earlier this year had a RINA stand at the Australian Oil and Gas Exhibition, supported by the Division Council. The success of this venture encouraged the section to run a separate stream in the associated AOG Conference next year covering the technical aspects of naval architecture, as well as having a stand at the exhibition. This event will join the list of official RINA-organised Conferences and Exhibitions for 2016.

The fourth major area I identified above, recreational craft, presents a dilemma. Whilst there are several members making a living in this area, there are many more in the sector who are not RINA members, because the recreational boating industry is, in essence, unregulated. Anyone can design and build a recreational craft regardless of their qualifications, and that creates two problems for us as a profession. Firstly a problem of safety. It is twenty-five years since the tragic loss of five young children when *N'Gluka* capsized in Port Stevens, caused by overloading. The only safety improvement which we have made since then is to fix a piece of aluminium near the transom, the Australian Builders Plate, which certifies the maximum number of persons which the craft can carry, the maximum amount of power for which the craft is designed, a stated amount of buoyancy, the manufacturer, and the name of the competent person who takes technical responsibility for the craft's design, but there is no requirement to investigate the actual stability characteristics and nothing else that I can think of in terms of inherent safety features. A RINA member would probably qualify as a competent person, but there is no legal requirement for such qualifications. Of course, there are some operational safety features such as lifejackets, but little else has been done to ensure that a tragedy such as that which befell *N'Gluka* cannot be repeated.

Secondly there is the problem of technical competence of the design of recreational craft. Most members in Fremantle will be aware that a 40 m luxury private yacht, a catamaran, was recently completed for a successful businessman, but any naval architect passing by can clearly see that there is one obvious design issue — the freeboard under the wet deck (the bottom of the structure joining the two hulls together) is extremely small. Articles in the local paper and stories around the waterfront suggest that the boat is many tonnes overweight and perhaps the designer, who is not a member of RINA and, I understand, may not have a naval architecture degree, did not appreciate that a low freeboard on a catamaran would cause the boat to slam and to be very uncomfortable in waves — not a desirable feature for a luxury yacht.

Some years ago, a similar 40 m luxury catamaran was also built in Fremantle and suffered from exactly the same problem. The ship's speed was several knots short of the contract speed and the craft slammed in waves.

This raises many questions in my mind. Why would a different designer some years later be ignorant of the previous vessel, particularly as it was built in the same town? Why would a successful businessman agree to have a luxury yacht designed by a person without at least RINA membership or other recognisable qualification? Was it really built without a contract, as stated in the local press, and reliance placed on a verbal agreement and a handshake? If the stories are true, there is a risk that such action puts our profession into disrepute.

A solution to this question of technical competence in recreational boat design is for RINA to raise its profile in Australia, to the point where any person, wealthy or otherwise, who wishes to have a boat built, of any size, automatically looks for a designer with qualifications, such as RINA or IEAust membership and appropriate professional registration such as with the Engineering Council. How this might be achieved is not obvious, and I would welcome any suggestions.

In summary, thanks to the hard work of our sections, our technical meetings across the country continue to cover every aspect of engineering where naval architecture skills are involved, including, but not limited to, the above four which I mentioned above. Long may this continue.

Wishing everyone a Merry Christmas (yes, it's almost here) and a Happy New Year.

Tony Armstrong

Editorial

The Pacific 2015 International Maritime Conference, held in Sydney on 6 to 8 October, was a great success. There were 339 delegates registered from Australia, Denmark, Finland, France, Germany, India, Indonesia, Israel, Italy, Japan, Malaysia, The Netherlands, New Zealand, Norway, Singapore, Sweden, the United Kingdom and the United States. The success of the conference was made possible by the efforts of the volunteers from the organising institutions who, over the preceding 18 months or so, put so much

effort into organising the programme, and the financial support of the sponsors. Of course, the IMC's partner, Maritime Australia Limited, organisers of the Pacific 2015 International Maritime Exposition, made it all possible.

This year's event was held at the temporary Sydney exhibition facilities at Glebe Island — in effect a large air-conditioned tent beside a wharf. As this centre does not have conference facilities, the IMC, the RAN Sea Power Conference and the sixteen other conferences and symposia during Pacific 2015 were held in very simple facilities set up in a display hall with some inevitable problems of noise. Despite these problems, which were well understood by everyone present, the conferences proceeded without any significant hitches.

Overall, Pacific 2015 was the biggest of the series held so far. The event attracted a record 494 exhibiting companies from 22 countries, including 40 from the US, 26 from the UK and 15 each from France and Germany. Visitors to the event totalled 14 979. The major participation by the Royal Australian Navy helped to attract a record number of 51 foreign delegations, many at Chief of Navy level. One might say that the event was heavy with brass!

Without doubt, Pacific 2015 was an outstanding networking opportunity for everyone present and, for professional engineers and naval architects, an excellent opportunity for continuing professional development. It is a pity that more RINA members from around Australia were not present — attendance at the International Maritime Conference was overwhelmingly by people who are not members of the Australian Division of RINA. Planning for the Pacific 2017 International Maritime Conference will begin soon. It will be held in early October 2017 in the new conference and exhibition facilities now being built in Darling Harbour. Put the dates in your diary now and come and join us for another outstanding event.

John Jeremy

LETTERS TO THE EDITOR

Dear Sir,

When I was a Naval Overseer at Cockatoo Dockyard in 1971–72, three catamaran crane stores lighters were being built for the RAN [*they are still in service today* — Ed.]. They were a development of the aircraft water lighter of 1968. Clip-on tugs and barges were also in the news at that time.

I could see merit in using those ideas for some ferry routes in Sydney Harbour. Accordingly I drew up a sketch with an accompanying letter which I sent to the Minister for Transport on 8 February 1974.

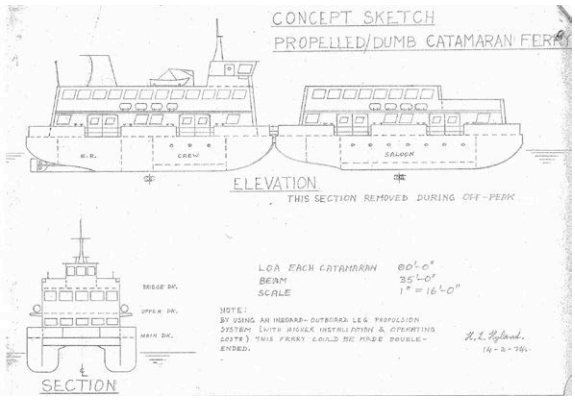
I suggested a powered catamaran with a clip-on dumb catamaran for peak periods to double the carrying capacity, just using the powered catamaran for off-peak giving a faster service speed. The concept is shown in the sketch. The dimensions of each catamaran were LOA 24.38 m and beam 10.67 m. While the dumb catamaran concept did not catch on, the powered catamaran concept appeared 10 years later in the form of the First Fleet class with LOA 25.4 m. Indeed, many more catamaran ferries have appeared around the world, boosted initially by their use when the road bridge in Hobart was badly damaged in 1975.

In my letter to the Minister I also urged the building of four new Manly ferries along with Sunday ocean cruises, and extending the other ferry services 50% to 100% to include many foreshore areas such as Watson's Bay, Nielson Park, Balmoral, Drummoyne, Abbotsford, Cabarita, Gladesville, and Rhodes. I also suggested more city ferry terminals including East Circular Quay, Sydney Cove 6, 7A and 7B, and Darling Harbour 6 and 7. I proposed combined ferry, bus and rail tickets. Every year or so I would follow up this correspondence.

Many of these ideas have come into being, so when you have a sensible idea, pass it on, preferably high up, and continue with a reasonable level of follow-ups. You never know what may happen.

Recently orders for a replacement catamaran design have been placed, with deliveries commencing next year.

Hugh Hyland



Hugh Hyland's Sydney Ferry concept of 1974
(Drawing courtesy Hugh Hyland)

Dear Sir

I am very interested in the use of composites in the shipbuilding industry. Since the mid-1980s, the use of composites in shipbuilding has increased considerably where they have commonly been used for the construction of ship hulls, decks, bulkheads and superstructures. Due to today's growing technology there is a vast amount of room for research and development, and I believe that the idea of composites being further implemented in shipbuilding should be of greater concern.

Composites have a higher strength-to-weight ratio than most other materials, resulting in a far lighter vessel which can achieve a higher speed than the same type of ship constructed of aluminium or steel, for example. This also means that smaller engines can be used and fuel consumption can be decreased, with obvious benefits. Another reason that composites are being implemented in shipbuilding is because they are non-corrodible. Unlike metals which corrode and decay, composites last for many years. Consequently, their non-corrodible property, coupled with their light weight and high strength, effectively results in less maintenance required, another key advantage.

However, despite all their favourable properties, composites must withstand the same rigorous testing as steel and

aluminium parts used in ships. To ensure that composites meet the demands needed for a seaworthy vessel, a variety of tests must be performed to simulate the effects of the ocean. The short-term goal of testing composites for use in the shipbuilding industry should be to design a lightweight, strong, low-cost and seaworthy vessel which will not corrode prematurely. The long-term objective should be to gain information which will be helpful in refining and improving the incorporation of composites in ship designs.

From a manufacturing point of view, steel is the most economical material for constructing large ships. However, over the ship's life it will continue to be costly for the owners in terms of maintenance and operation during its usage. Composites, however, conserve significant amounts of fuel and require less maintenance where, over a ships' life, the use of composites would prove to be cheaper despite their high up-front costs.

Composites have numerous benefits and, if utilised to their full potential, could help shipbuilders leap into a profitable future. I hope that they will be continued to be improved and further developed for increased use in the shipbuilding industry.

Geoff McCarey
UNSW Student

NEWS FROM THE SECTIONS

ACT

Since the last ACT Section update in the May 2015 issue of *The ANA,* the ACT Section has hosted a number of technical presentations jointly with the South East Australia Branch of the Nautical Institute (NI). The attendance at the technical presentations this year has been encouraging and much improved over recent years.

On Tuesday 20 May 2015 James Heydon gave a presentation entitled *Quantifying the Resistance of Fouled Paint* at the Directorate of Navy Platform Systems (DNPS) offices in Campbell Park, Canberra. James is a naval architect who recently joined the DNPS after completing his naval architecture degree at UNSW in 2014. His presentation was an overview of his thesis project covering the experimental and CFD analysis undertaken to investigate the effect of marine fouling. Included was the background of environmental conditions and affected structures in the marine environment. He discussed the feasibility of a rotary-type test apparatus in quantifying the resistance of a number of applied anti-fouling coatings. The results of the CFD analysis used to simulate the experiment were presented along with the validation against experimental results from tests undertaken on a similar rig at the School of Marine Science and Technology at the University of Newcastle in the UK some years ago. The presentation drew interest from those in the marine materials field and those with an interest in the current standards of CFD simulation.

On Tuesday 16 June 2015, Dr Tim Gourlay, a Senior Research Fellow at the Centre for Marine Science and Technology (CMST) at Curtin University, gave a presentation on the *Under-Keel Clearance of Frigates and Destroyers in Shallow Water* at the DNPS offices. This presentation was possible as Tim was also visiting Canberra to provide a CMST short course on seakeeping to DNPS staff. Tim has worked in the field of hydrodynamics in academia since 2000 at both CMST and the Australia Maritime College (AMC). The presentation covered the importance of understanding the phenomena of squat and wave-induced motions for naval ships operating in shallow water to avoid grounding. He discussed the current research in the field of shallow-water hydrodynamics, highlighting the important phenomenon of trans-critical squat. The implications for frigate- and destroyer-type ships were discussed using some well-known groundings, including the cruise ship *Queen Elizabeth 2* which grounded in August 1992 due to a combination of her speed, an uncharted shoal and underestimating the increase in the ship's draft due to the effect of squat. The presentation drew a large and interested crowd of both RINA and NI members as well as interested non-members from Defence, AMSA and the ACT area, and prompted a range of questions.

On Tuesday 28 July 2015, Tom Dearling, a Senior Naval Architect with QinetiQ, gave a presentation entitled *LHD — A Technical Presentation* at the DNPS offices. Tom was the DMO Project Naval Architect on the LHD acquisition programme from August 2012 to December 2014, covering approximately the period of time from the hull of Ship 1 arriving in Australia to the completed HMAS *Canberra* being delivered to the RAN. His presentation gave a technical overview of Australia's new LHDs, HMAS *Canberra* and NUSHIP *Adelaide*, from a naval architect's perspective. It covered overall design, capabilities, and major systems as well as the test and trials programme which the ship undertook. Also covered was the Lloyd's Register class notation which the ship was built under and the application of commercial safety standards to a naval vessel. In contrast, the Spanish Navy ship *Juan Carlos I*, on which the RAN LHDs are based, is not classed and this has led to a number of differences in systems between the ships, aside from those specifically sought by the Department of Defence. The presentation prompted a range of questions, particularly concerning the various class notations.

On Tuesday 22 Sept 2015, Jillian Carson-Jackson, Vessel Traffic and Pilotage Services Manager at AMSA, gave a presentation on *The VHF Data Exchange System* (VDES) at the AMSA offices at Braddon, Canberra. Jillian is the Chairman of the SE Aust. Branch of the NI and this presentation was jointly presented by NI and RINA and was hosted by NI. Jillian's presentation covered the exciting developments in maritime radio communications. AIS is well recognised and accepted as an important tool for safety of navigation and is a carriage requirement for SOLAS vessels. However, because the technology is so effective and useful, the use of AIS and AIS-like technologies has expanded to include a number of completely different applications. Jillian discussed the significant increase in VHF Data Link (AIS VDL) loading caused by the expanding use of AIS which has become an active concern in IMO and ITU. Because of increasing demand on the radio spectrum for digital communication, such as mobile phone and data, ITU now requests more the efficient and effective use of the radio spectrum. The VHF Data Exchange System (VDES) is

seen as an effective and efficient use of the radio spectrum, building on the capabilities of AIS and addressing the increasing requirements for data to be transferred through the system. Jillian also discussed new techniques, providing higher data rates than those used for AIS, becoming a core element of VDES and current work that is underway to ensure that more data can be transferred with a very high confidence of reception.

Caitlin Hoey

Victoria

Annual General Meeting

The AGM of the Victorian Section was held on Thursday 20 August 2015 in the Auditorium at Jacobs, 452 Flinders St, Melbourne.

As a result of the elections, the Victorian Section Committee now comprises

Chair	Andrew Mickan
Secretary	Siobhan Giles (siobhan.giles@dsto.defence.gov.au)
Treasurer	Trevor Dove
ADC Nominee	Karl Slater
Members	Joseph Cook
	Colin Johnson
	Lance Marshall
	Jack Osborne
Co-opted Member	Hugh Torresan

Rapid Ship Design Evolution

Aidan Depetro, Senior Engineer at BMT Design & Technology, gave a presentation on *Rapid Ship Design Evolution Using Computer Algorithms* to a joint meeting with the IMarEST attended by twenty on 20 August 2015 in the Auditorium at Jacobs, 452 Flinders St, Melbourne.

Traditional ship design methodologies involve a manual, iterative and evolutionary design approach. Whilst this has proven to be robust and reliable, it is generally labour intensive, time consuming and reliant on a firm understanding of requirements. The design of flexible platforms for exclusive economic zone and related operations presents some unique design challenges which would benefit from a rapid and adaptable approach, particularly in the early stages of design.

This is particularly relevant for the design of multi-role vessels where many different role combinations and fleet mixes are possible, each with their unique capability traits, manning requirements, advantages and disadvantages. Due to the extensive time and resource investment required to generate multiple design concepts, the traditional design approach does not easily lend itself to rapid trade-off, cost-benefit and options analyses where many different solutions are required to be synthesised and evaluated.

This presentation detailed the use of genetic and other algorithms to automate the ship design process to enable the rapid evolution of many ship design concepts. The use of this methodology was demonstrated with the particular application multi-role vessels.

Aidan graduated from Royal Melbourne Institute of Technology with a BEng in Mechanical Engineering. Early in his career, he worked for the Ford Motor Company before joining BMT Design & Technology as a Mechanical Engineer in 2008. In 2010 he was seconded to the UK for 12 months, working for BMT Reliability Consultants during which time he completed a number of projects for the UK MoD and local industries.

Since returning to Australia, Aidan has continued his work with the defence and commercial industries on projects including detailed design, cost-benefit and risk analysis, mathematical modelling of costs, risk, emissions and other parameters whilst being a key developer of BMT Design & Technology's submarine design exploration application. In 2014, he was recognised for his outstanding individual contribution to Defence and Industry when he was awarded the Australian Industry and Defence Network (AIDN) National Young Achiever Award.

Walter Atkinson Award 2015 to Roger Neill

Dr Roger Neill of DST Group (formerly DSTO) received the Walter Atkinson Award for 2015. Roger Neill presented his work on the HMAS *AE2* Archaeological Assessment with Dr Ian Macleod of the WA Museum to members of RINA and IMarEST in August 2014.

The award was presented to Roger at the Cocktail Reception for the Pacific 2015 International Maritime Conference in Sydney on 7 October by the Chief Executive of RINA, Trevor Blakeley.

Congratulations to Roger on his achievement.

Turret Options for the Schiehallion FPSO Re-deployment

Goran Dubljevic, Manager Floating Systems for Wood Group Kenny, gave a presentation on *Analysis of Turret Options for the Schiehallion FPSO Re-deployment* to a joint meeting with the IMarEST attended by twenty on 22 October 2015 in the Auditorium at Jacobs, 452 Flinders St, Melbourne.

The client was considering deploying the Schiehallion FPSO to offshore Brazil. The objective of the analysis was a high-level assessment of various turret options to minimise production downtime between well tests. The Schiehallion FPSO is currently equipped with an internal non-disconnectable turret.

A short list of technically-feasible options was provided for operation of the system over eight years, considering eight connection/disconnection procedures while focusing on maximising uptime.

The analysis presented the results of the following:

- High-level non-economic study on current turret technologies and major turret suppliers.
- HSE issues related to various turret configurations.
- Options available for Schiehallion turret conversion to match Petrobras' requirements.
- A comparative evaluation that determined availability and downtime associated with various types of turret, mooring and tandem offloading systems for use in Brazil, taking into consideration the site metocean data.
- Assumptions on riser configuration
- Deepwater riser installation, transfer, wet parking and recovery issues.

The results of the analysis demonstrated that two new

disconnectable external turrets represented the most-suitable solution to minimise production downtime. Conversion of the Schiehallion FPSO and integration of an external custom-made disconnectable turret at the bow (RTM) was considered the most viable option when the client's requirements were taken into account.

Goran Dubljevic is a professional engineer and multidisciplinary team-management practitioner with over 28 years of experience across a wide range of industries including oil and gas, shipbuilding and ship repair, mining and aerospace. He has had first-hand exposure to a number of international ship/marine structures design, integration, construction, installation and repair activities from technical, commercial and managerial perspectives.

Throughout his career Goran has been involved in design, construction and systems integration activities as well as risk and safety-case development and review activities for FPSOs, tankers, tugs, workboats, patrol boats, frigates, hovercraft, passenger ferries and other non-self-propelled floating structures.

He has extensive experience in shipyard management as well as shipyard production management. He has led multidisciplinary teams in delivering several international EPCM shipbuilding/marine structure projects.

He has performed the role of Project Director, having oversight of assurance on an assigned portfolio of projects executed under e-capital project assurance processes. The duties included client liaison, interface management, conflict resolution, peer review, audit and compliance.

Andrew Mickan

New South Wales

Committee Meetings

The NSW Section Committee met on 10 September and, other than routine matters, discussed:

- SMIX Bash 2015: Sponsorship requests have been slow to send out, but are gathering momentum; tickets will go on sale next week, with advice to members first and advice to friends three weeks later.
- TM Program 2016: Two presentations have been pencilled in for March and May next year, with suggestions made for others and prospective authors to be contacted.
- Recording of TM Presentations: Only one presentation has been recorded this year.
- Visit of Chief Executive: Possible events discussed.
- Crewing RINA Stand at Pacific 2015: Part-roster drawn up, but help expected from other RINA members attending Pacific 2015 IMC.

The NSW Section Committee also met on 22 October and, other than routine matters, discussed:

- SMIX Bash 2015: Sponsorships coming in and ticket sales have commenced; venue has been paid for, and menu is being discussed with caterers.
- TM Program 2016: Presentations have been pencilled in for March, May, July, September and October, with dates to be confirmed with presenters.
- Pacific 2015 IMC: The attendance of 339 was the highest since 2010.

The next meeting of the NSW Section Committee is scheduled for 26 November.

Submarine HMAS *AE2*

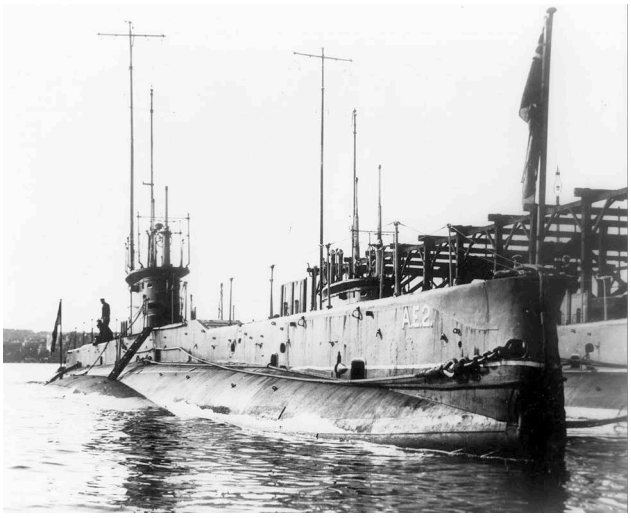
Roger Neill and Martin Rowan of the Defence Science and Technology Organisation (now DST Group) gave a presentation on *The 2014 Maritime Archaeological Assessment of the Sunken Submarine HMAS* AE2 to a joint meeting with the IMarEST attended by forty-one on 1 July in the Harricks Auditorium at Engineers Australia, Chatswood.

Introduction

The presentation was begun by asking the question *Why is DSTO interested in the science and technology of World War I?*

Traditional modes of warfare were being replaced by revolutionary new technologies; for example, horse-mounted cavalry was a fading capability. Potent new capabilities based on tanks, aircraft and submarines, which were game changers, were being introduced.

The Royal Navy's first submarine (HMS *Holland 1*) entered service in 1901. She was revolutionary when new but was soon superseded. In 1915, Australia's E-class submarines (HMAS *AE1* and *AE2*) were state of the art — they were of large size and had modern lines. These were highly-capable submarines, a product of 20th Century science.

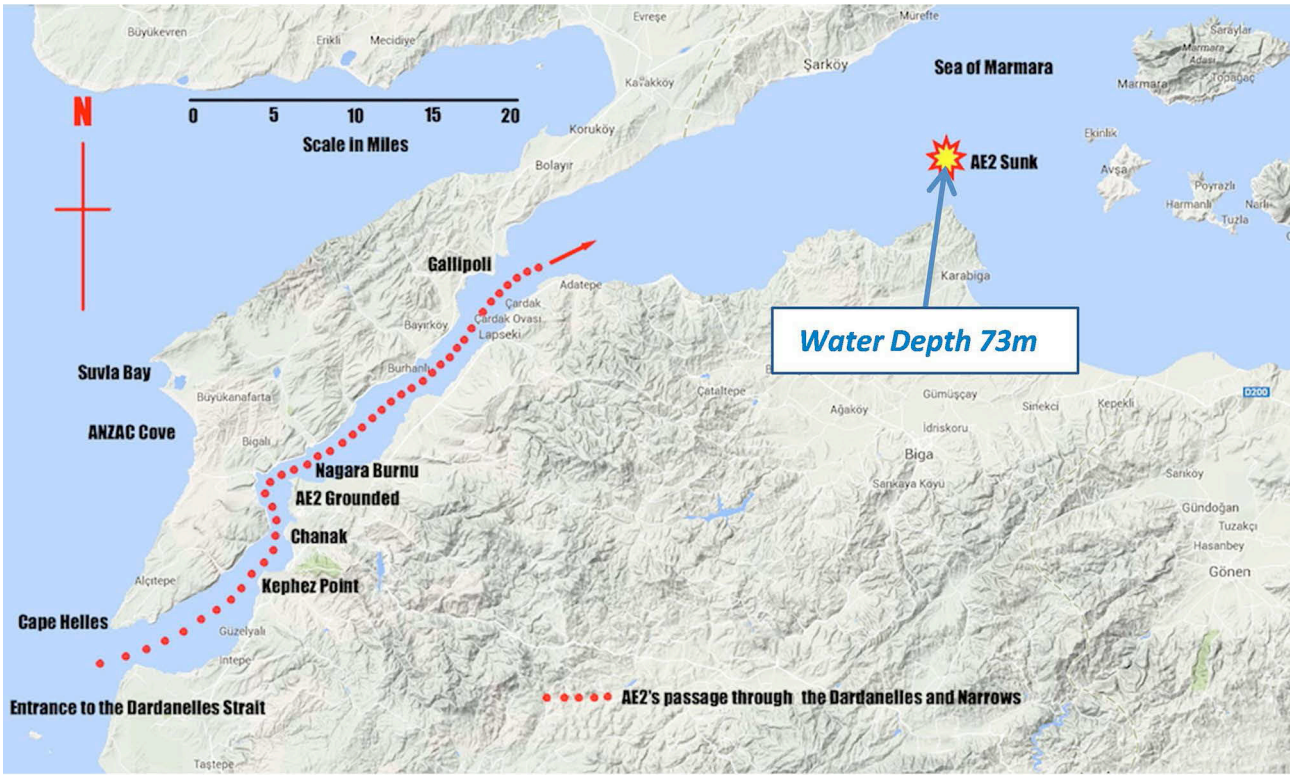


HMAS *AE2* docked in Sydney in 1914
(Photo RAN Historical Collection)

AE2, under the command of Lieutenant Henry Stoker, RN, was the first allied vessel to penetrate the Dardanelles on 25 April 2014. The submarine made appearances across the Sea of Marmara over the following five days to give the impression of multiple boats, and several attacks against Turkish ships were made, although all failed because of increasing mechanical problems. The vessel was eventually scuttled on 30 April while under fire on the surface from a Turkish gunboat.

There is much that we do know about *AE1* and *AE2*: they were large (for the day) at 600–800 t displacement, were powered by twin 8-cylinder diesel engines, carried 8 torpedoes, had advanced Sperry gyro compasses, sophisticated ballasting systems, radio telegraphy units and unique periscopes for enhanced target tracking.

However, there is also much that we do not know, because *AE2* took secrets to the seabed with her. There are many unanswered questions in the technical, operational, human and archaeological areas, and we needed to enlist 21st



Location of HMAS *AE2*
(Diagram courtesy DSTO)

Century science to answer these and many more questions. DSTO's unique capabilities enabled them to support the project through deep knowledge of submarines and submarine warfare technology, rapid prototyping and development techniques, expertise in underwater robotics, and linkages with defence, industry and academic partners. The DSTO AE2 Marine Archaeology Assessment (MAA) participants included:

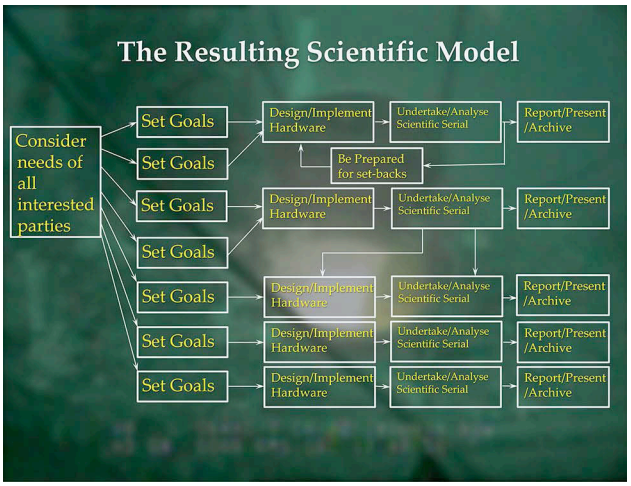
Dr Roger Neill	Scientific Director, AE2 ROV Operations Manager, BLENDER Specialist, and Director of Data Analysis.
Mr Peter Graham	Electronics Engineer, Chief ROV Pilot, and Ship-based Data Management.
Mr John Gilbert	Mechatronics Technician, ROV Pilot, and 'all rounder'.
Mr Martin Rowan	Lead Mechanical Engineer, MRTE Trials Manager—Australia, ROV Pilot, and Logistic Support.

Objectives

While adhering to Turkish and Australian Government requirements and maritime archaeology conventions, the general objectives of the scientific program included:

- Assess the effects of corrosion on the submarine.
- Assess the environment inside the submarine — does a 'micro-environment' exist within the hull?
- Assess the overall physical state of the submarine — 2014 vs 2007.
- Collect detailed archaeological information from inside the boat to assist in:
  - enhancing the knowledge of the state of preservation of the vessel;
  - building understanding of how early submarines were operated; and
  - 'Telling the Story'.
- Develop methodologies and representative technologies which may be applicable for use in other relevant research programs.

A complication was to design a scientific program which would meet the needs of the "target audience", because many people have an interest in these surveys. These include corrosion scientists, environmental scientists, maritime archaeologists, naval historians, submariners past and present, the Governments of Turkey and Australia, and the general public. These were all taken care of in the resulting scientific method.



Resulting scientific method for marine archaeological assessment of *AE2*
(Diagram courtesy DSTO)

Sensors were sent inside *AE2* to

- Establish *AE2*'s condition, from a corrosion-protection perspective.
- Assess the environment inside the submarine: is it a "micro-environment "?
- What has changed since MAA2007?
- Undertake a detailed internal archaeological survey:
    - Explore the 20th Century Technology.
    - What was life like for the crew?
- Tell the Story.
- Develop methodologies and representative technologies that may be applicable elsewhere.

Internal investigations of sunken vessels have implications. These include the maritime archaeological implications, the scientific and operational risk, and the need for bespoke technology.

Maritime Archaeological Considerations

The concept of 'progressive intrusion' means

1. Baseline measurements on the undisturbed submarine (negligible disturbance).
2. Open the hatch and insert an augmented instrument suite (minimal disturbance).
3. Insert the ROV and *progressively* enter the boat.

Over-arching principles are to take nothing, leave nothing, minimise disturbance, and document unavoidable disturbance.

Managing Scientific and Operational Risk

Forward planning for the survey included two mission rehearsals using a fabricated replica submarine in Corio Bay (in the south-west corner of Port Phillip). The plan was to succeed, but to be prepared for the unexpected. Safety was paramount. They planned to avoid single points of failure by rehearsing and catering for field serviceability.
Some things that didn't quite go to plan are shown in the table.

Things that didn't quite go to plan	Work-around Successful?
Things that didn't fit where they were meant to:	
Undocumented casting in upper hatch blocked camera	✓
Jack jammed under the jumper wire	✓
ROV didn't fit through lower hatch	✓
Various minor equipment failures	✓
Contractor-supplied gear not meeting wiring standards	✓
Weather	✓
Divers showed evidence of fatigue	✓

Things that didn't quite go to plan on *AE2*
(Table courtesy DSTO)

Bespoke technology should only be used where necessary. For external surveys, general support and diver support, commercial equipment was used. However, for internal surveys, bespoke technology was needed for camera systems, lighting, the ROV, and specialised mounting and cable handling.

The Program

During the scuttling of *AE2*, LEUT Stoker partially closed the conning-tower hatch to ensure that *AE2* flooded completely. Stoker's action of securing the hatch partially-open 100 years ago gave some cause for concern in developing equipment to insert through the small hatch opening (approximately 100×250 mm) whilst minimising disturbance of the water column and submarine structure.

The initial (and potentially most critical) MAA14 serial (task) was to insert a high-definition (HD) camera, high-quality lighting and a water-quality sampling device through the existing hatch opening. The aim was to gather HD video and water samples from the conning tower through to the deck of the control room at 300 mm intervals whilst attempting to minimise disturbance of the water column. A bespoke camera and lighting system (taking advantage of lessons learnt from the camera system used during 2007), and a multi-purpose real-time submarine-to-surface communications and control system was devised and constructed by Peter Graham and John Gilbert, known as the 'drop-camera', to achieve the above aims.

A serial represents an activity which has been designed to be executed by a diver during one 20-minute dive cycle, such as inserting, operating and removing a camera system, or opening/removing the conning-tower hatch.

The MAA14 diver-executed serials were:

Serial 1	Diver Support Platform (DSP) placement on AE2.
Serial 2	Diver insertion, rotation, lowering and removal of the drop-camera and sonde water-sensor system through the current conning-tower hatch opening.
Serial 3	Opening of conning-tower hatch cover (open or remove).
Serial 4	DSP attachment, insertion, calibrated rotation and lowering of the pole-camera system (incorporating ARIS 3000 Sonar).
Serial 5	DSP setup and attachment of SeaBotix vLBV remotely operated vehicle (ROV) and tether-management pole system.
Serial 6	Secure submarine with substitute hatch and remove DSP.

Mission Rehearsal and Testing Exercise 2013

In preparation, a Mission Rehearsal and Testing Exercise 2013 (MRTE13) took place at Corio Quay, Geelong, Vic., in December 2013 to evaluate the proposed MAA14 Serials. Five Serials were rehearsed on three *AE2*-replica sections which had been manufactured in Victoria and placed in 12 m of water off the wharf. The Diver Support Platform was deployed, the RAN's reserve diving team (RANDT6) provided diver support and valuable feedback for all serials, and the whole MRTE was observed by four Deep Offshore diver representatives from Turkey.

Outcomes of the MRTE included

- The DSP is suitable for all diver operations.
- Time management of the 20 mins of diver time on *AE2* for diver execution of activities were critical, and equipment deployed to and operated by a diver *must* be designed to enable all activities to be completed within 20 mins *without exception*.

- Robust, simple diver-installed and operated camera systems attached to and deployed from the DSP were crucial.
- Independent ROV tether-monitoring should be investigated to improve ROV operator awareness of the trailing tether in such a confined and potentially-cluttered environment inside *AE2*'s pressure hull.

Diver Support Platform

The Diver Support Platform had dimensions of length 5.15 m, width 4.64 m, and height 4.05 m, and had a mass of 1.3 t. The concept was for it to straddle the conning tower of the submarine and rest on the port and starboard ballast tanks, without being fixed in place.

The Diver Support Platform
(Photo courtesy DSTO)

The specifications show that the DSP is a substantial structure and it was no mean feat to place on *AE2* at a depth of 73 m by a fairly-basic ship crane and manoeuvred underwater by a ROV. And especially when you consider the multi-lingual lines of communication: an American ROV operator updating an Australian dogger instructing a Turkish interpreter instructing a Turkish (and sometimes *very* cranky) crane operator on a ship at sea in a swell — good luck! However, at times a very difficult task, but eventually achieved.

MAA14 Technical Challenges Addressed by DSTO Post MRTE13

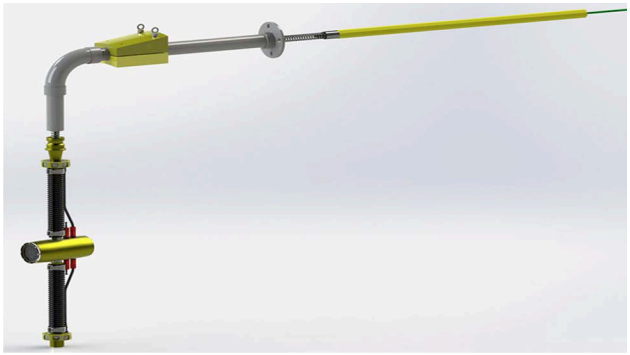
Serial 2	Diver insertion, rotation, lowering and removal of the drop-camera and sonde water-sensor system through the current conning-tower hatch opening.
Action	Minor improvements made to the current bespoke drop-camera system. Both systems required diver assistance to install, operate and remove in a 20 min dive serial
Serial 4	DSP attachment, insertion, calibrated rotation and lowering of the pole-camera system (incorporating ARIS 3000 Sonar).
Action	Improved the system to enable a diver to accurately lower, rotate and orient the pole-camera system using 'feel' by providing the diver with perceptible confirmation that each step (e.g. lower 300 mm, orient and rotate 360°) had been achieved if visibility at 73 m was very poor.
Serial 5	DSP setup and attachment of vLBV and tether-management pole system.
Action	Developed an automated pole-camera rotation system to be inserted into the control room concurrently with the vLBV and tether-management pole system. The automated pole-camera rotation system could be controlled from the surface without deploying another tether to the submarine.

Drop-camera

Here the authors showed a series of slides, illustrating where various items were located on the drawings of the submarine, together with comparison photos taken of the items in 2007 and 2014, including

- the aft periscope;
- the conning-tower viewing scuttle;

- control-room hatch and fibrous seal;
- the steering shaft universal joint; and
- control-room gauges on the starboard side.



The drop camera
(Photo courtesy DSTO)

Pole Camera

For Serial 4, the drop camera was re-configured to form the pole camera, which could be inserted through the substantially-open conning-tower hatch cover (opened in Serial 3). The pole camera was attached to the DSP, and could be operated and controlled by a diver from above. The apparatus was mounted at the base of an aluminium pole which had 13 grooves machined into it at 300 mm centres to aid diver 'feel'. From top to bottom at the base of the pole, the items included an LED light array, the isofloat casing, an HD camera, an Aris 3000 sonar, and another LED light array. With the pole camera, the inclusion of the Aris sonar and better diver control mechanisms allowed for the possibility of:

- achieving video imagery of unprecedented quality of much more of the interior of the conning tower and control room; and
- using sonar data to build a three-dimensional 'wire frame' model of these compartments, and then draping the imagery over the model.

In the event, it took much longer than originally planned to position the DSP and to open the upper hatch. This meant that, unfortunately, the full pole-camera deployment was not undertaken. It was, however, possible to undertake a truncated deployment on the final day of the mission. Limited data were recorded, but the quality of the results indicated that this would be a very worthwhile serial to undertake if a future mission is undertaken.

Remotely-operated Vehicle

Another major objective of MAA14 was to insert a ROV into the submarine and carry out planned transits throughout the submarine.

SeaBotix Pty Ltd, a USA manufacturer of remotely-operated vehicles (ROV), re-designed one of their vLBVs (vectored Little Benthic Vehicles) to undertake the internal survey of AE2 by

- reducing the physical size to fit through both hatches, based on available *AE2* drawings, with an estimated allowance for reduction in the size of the opening through concretion;
- installing angled low-power thrusters to minimise disturbance of sediment within the submarine;

The pole camera and Aris 3000 sonar
(Photo courtesy DSTO)

- adding a rear-mounted camera;
- relocating the tether-attachment location to the top to enable the tether to be drawn into the protective aluminium pole, thus protecting the tether from 'Bunts' (a large conger eel in residence); and
- integration of an Aris 3000 sonar.

For this operation, an additional aluminium pole was required (alongside that for the pole camera) and the vLBV's tether-management system was deployed through this and controlled from the surface. The combined ROV pole-support system was readied and suspended from the ship's crane for deployment 73 m below for insertion into *AE2*. However, as Robbie Burns said "The best-laid plans of mice and men gang aft agley" (often go awry), and the vLBV became well-and-truly jammed in the lower hatch

opening, above the control room. How to free it, 73 m deep in the Sea of Marmara? It took the collective wealth of experience on board the ship to eventually come up with a potential recipe for success. It took a proven survivor of the 2007 expedition (not Ken Greig or Roger Neill, but the SD Drop camera!), a stainless-steel boat hook, a diver's torch, a roll of gaffer-tape, and one hell of a big Turkish diver! And it worked; the ROV came free. However, the next question was "How can we survey inside the submarine without the purpose-built vLBV."

DSTO's LBV

DSTO's LBV150 was nominated for the challenge, and reconfigured to be deployed vertically through both hatches by producing a simple weight–and-float combination which could be released and retrieved by the LBV's 'grabber'.

Tension was high, particularly when we were advised, in no uncertain terms, that it would the last dive allocated to insert a ROV. From DSTO's point of view, failure to insert a ROV meant that one of the major objectives of the expedition would not be realized, and so failure was not an option! A sleepless night, an anxious trip to the site, and on-the-deck reconfiguration of the articulation-and-support system was deemed (using a grinder and a couple of spanners) the most-likely procedure to succeed if careful control of the crane operator and divers could be managed.

The LBV was successfully inserted, eventually, through both hatches and, somewhat unexpectedly, the quality of images from the SD camera was startling. The results speak for themselves. And the little hero (DSTO's LBV150) safely returned to the surface!

Cameras

It was interesting, and surprising, to note how many cameras, both planned and unplanned, were used during the expedition, as can be seen from the list:

- Drop-camera MkII (HD)
- Pole-camera (HD)
- Seabotix vLBV (2 units) (HD)
- Diver's Helmet Camera (SD)
- Dive Bell GoPro (HD)
- DSTO's LBV150 ROV (SD)
- Drop-camera MkI (SD)
- SeaBotix's GoPro (HD)
- Sensible Films' Documentary and GoPro cameras (HD)
- ABC's GoPro (HD)

Collectively there were approximately 12 terabytes of video and sonar footage recorded.

The preliminary analysis of the video footage has identified 214 internal items:

Conning Tower	35
Control Room (Fwd)	118
Control Room (Aft)	35
Ward Room	26

Corrosion Protection

Anode pods were fitted to *AE2* for protection against corrosion, and she now has the world's largest corrosion-protection system installed on a maritime war relic.

Kingston wheel in the Control Room
(Photo courtesy DSTO)

Anode pods were attached aft near the rear hydroplane, amidships at the conning tower, and forward on the windlass. Each anode pod contains 17 zinc anodes, each 1500×75×75 mm, totalling 1.5 t in each pod.

Entry Protection

The conning-tower hatch was fitted with a fibreglass top hat manufactured by RPC Technologies to prevent unauthorised diver entry. This was secured to the conning-tower hatch opening by a keyed system, and the Turkish Government retains the key. The top hat was designed to allow Bunts to enter and exit as before. However, we are not sure whether Bunts is happy with the 'renovation'.

Conclusion

There were some significant conclusions drawn from MAA14. The internal fabric of *AE2* is in excellent condition, even after 100 years on the sea-bed of the Sea of Marmara. Many of the mechanical systems which were revealed by the survey are either not documented in available plans, or are different from those expected. There is considerable evidence that the crew modified or adapted the boat to enhance (or in some cases simplify) its operational capability. It was also evident to the analysts that *AE2*'s crew had maintained the vessel in a "ship-shape" condition during the week of their operation in the Sea of Marmara.

At a more personal level, this was the opportunity of a lifetime to participate in an expedition of this nature. The cooperation and friendships established between the Turkish and Australian participants was exceptional. On several occasions, significant problems were encountered which could have terminated the expedition prematurely, but the collective wealth of experience and broad range of expertise on board the ship was able to devise solutions to all problems encountered during the survey. Re-configurability of the various systems proved to be of great benefit when ad-hoc changes to equipment were required to adapt to work around previously unknown structural fixtures.

Thankfully, all objectives of MAA14 were achieved.

The vote of thanks was proposed, and the certificate and "thank you" bottle of wine presented, by Craig Boulton. The vote was carried with acclamation.

PureDry

Selwyn Oliveira, Marine and Diesel Manager at Alfa Laval Australia, gave a presentation on *PureDry: Reducing a Ship's Fuel Costs by Re-using Waste Fuel Oil* to a joint meeting with the IMarEST attended by nineteen on 2 September in the Harricks Auditorium at Engineers Australia, Chatswood.

Introduction

Selwyn began his presentation by saying that PureDry is innovative technology from Alfa Laval. They have moved on from oily bilge-water separation to waste fuel oil. There is plenty of waste fuel oil on board ships, apart from leakages, from lots of sources. Fuel oil recovered from a 100 m^3 waste fuel oil tank could save USD 32 500 per year. Sources include fuel-settling and service tank bottom drains, automatic fuel oil filters, fuel injection pumps, fuel oil purifier sludge tanks, boiler burner leakages, drip trays under fuel transfer pumps, pipe leakages, incident fuel spills and fuel oil waste tank cleanings, etc.

Waste Fuel Oil Content

Analysing the content of a waste fuel oil tank, we find

45–55%	Fuel oil
55–45%	Oil-polluted water
≈1%	Suspended solids

As an example, a 100 t waste fuel oil tank would yield 49.5 t of fuel oil (with a maximum of 60 ppm catfines and 1% water, worth $US32 500), 49.5 t of water (with a maximum of 100 ppm oil), and 1 t of solids (with approximately 7% catfines).

Rules and Regulations

The International Maritime Organisation (IMO) issued a Circular from the Marine Environment Protection Committee, MEPC.1/Circ.642 on 12 November 2008, titled *2008 Revised Guidelines for Systems for Handling Oily Wastes in Machinery Spaces of Ships Incorporating Guidance Notes for an Integrated Bilge Water Treatment System (IBTS)*.

Relevant extracts from Circular 642 include:

5. Definitions for the purpose of the Guidelines

5.1 Oily waste means oil residues (sludge) and oily bilge water.

5.2 Oil residue (sludge) means the residual waste oil products such as those resulting from the purification of fuel or lubricating oil from main or auxiliary machinery or separated waste oil from bilge water separators, oil filtering equipment or oil collected in drip trays, and waste hydraulic and lubricating oils.

4.6 Re-generating fuel oil from sludge

4.6.1 Oil residue (sludge) may be used onboard as re-generated fuel. Oil residue (sludge) is collected in an oil residue (sludge) tank prior to processing (disposal) back into the fuel oil system as re-generated fuel oil.

4.6.2 Oily drains should be recorded in the oil record book as any other oil residue (sludge) collection.

4.6.3 Re-generation of fuel oil from oil residue (sludge) should be an approved means of disposal of oil residue (sludge) according to the Supplement to the IOPP Certificate.

4.6.4 The re-generating process may include filtration, decanting or purification to remove unwanted heavy parts from the oil residue (sludge).

In addition, MARPOL Annex I, Unified Interpretation of Reg. 12.1 says:

16.1.2 When such ships are fitted with homogenizers, sludge incinerators, or other recognised means onboard for the control of sludge, the minimum sludge tank capacity (V_1) should, in lieu of the above, be:

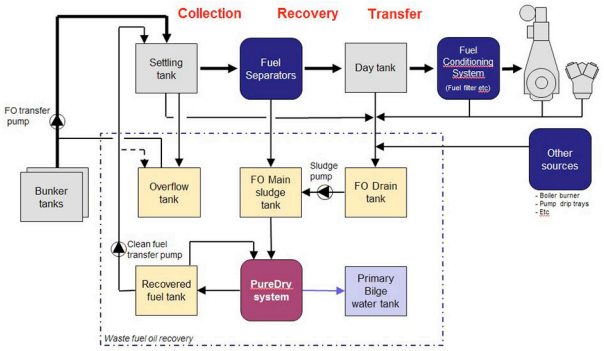
V_1 = 1 m^3 for ships of 400 gross tonnage or above but less than 4 000 gross tonnage, or

2 m^3 for ships of 4 000 gross tonnage and above.

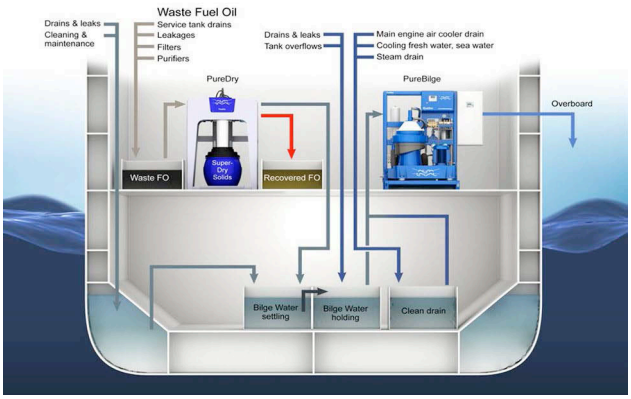
The PureDry Process

Waste fuel oil has to be kept separate from waste lubricating oil; i.e. recovered lube oil is not acceptable as re-generated fuel for diesel engines due to its high additive content.

The PureDry integrated process is shown in the diagrams.



The PureDry integrated process
(Diagram courtesy Alfa Laval)



The PureDry bilge system
(Diagram courtesy Alfa Laval)

The waste fuel oil is split into water, with <100 ppm oil, fuel with <1% water, and super-dry solids (which are not pumpable). The PureDry system operates with continuous discharge of separated fuel, water and solids. The operation is automated and adaptable to varying feed conditions. Systems are available as a complete module or as individual units.

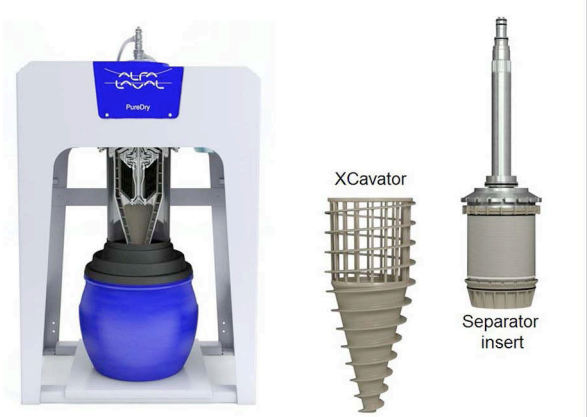
PureDry process steps include pumping, demulsifier dosing, heating and separation.

PureDry Separator Design

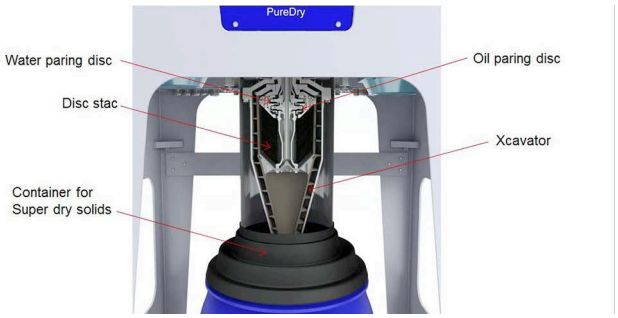
The separator is the heart of the PureDry system. It separates oily waste of varying composition and density

A PureDry module
(Image courtesy Alfa Laval)

without adjustment, and provides continuous discharge of separated fuel oil and water. Cleaning in place is not needed. Automated operation is provided, and is adaptive to varying feed conditions.



The PureDry separator
(Image courtesy Alfa Laval)



The PureDry operating principle
(Image courtesy Alfa Laval)

The basic principle is that of a centrifuge which utilise g-forces to split water, oil and solids into three distinct phases. At the top of the separator insert there is a water-paring disc above the oil-paring disc which pump out the water and oil respectively by converting the kinetic energy of the liquid into a pressure head. Solids are thrown to the outside, and moved downwards by the Xcavator, and collected at the bottom as super-dry solids which are too dry for pumping.

The output treated-water stream from the process is directed to a bilge holding tank, recovered fuel oil to bunker tanks, and dry solids go ashore as dry waste.

Maintenance and service is by exchange (MSE). One complete set of MSE parts is included with PureDry delivery. There is a one-year or 8000 operating hours recommended exchange interval of the separator insert (dependent on actual operating hours), Xcavator and a service kit.

Technical details of the PureDry system include

Nominal capacity		500 L/h
Medium		Waste fuel oil
Process temperature		80–90°C
Power consumption		maximum 7 kW (complete system)
Utilities	Electrical	400/440 V 50/60 Hz
	Air	200–800 kPa
	Water	300– 600 kPa
Demulsifier dosing		Alpacon 207

The scope of supply for the PureDry system includes the heater unit, control unit, separator unit, pump unit and demulsifier dosing unit. If the PureDry module is selected, then the heater unit, control unit and separator unit are supplied mounted on a common frame. Also included with delivery is one major exchange kit, one set of tools, and one 25 L container of demulsifier.

PureDry Fittings

So far, the following companies have fitted PureDry systems to their vessels:

Frontline	40+
Mediterranean Shipping Company	40+
Wallenius Marine	4
Stena	10
Silja Line	1
Royal Caribbean Cruise Line	1
Norwegian Cruise Line	5
Carnival Cruises	40+

Most of these are fitted to newbuilds, but some (especially the cruise vessels) are retrofits.

A case study on one of the cruise vessels having a main engine power of 33 MW showed that, after one year in operation, the vessel had recovered 150 t of fuel oil, worth about $US40 000.

PurePay

PurePay is an Alfa Laval-developed Excel spreadsheet calculator which allows an owner to calculate the payback period for installation of a PureDry system. It takes into account the engine size, fuel cost, installation cost, waste disposal cost, and shows the payback period. If it is more than two years, then don't bother!

PurePay is available for download from the PureDry site at Alfa Laval Share:

http://work.alfalaval.org/virtual/oilywastetreatmentcollaborationsite/Shared%20Documents/PurePayWFR_v105.swf

Conclusion

PureDry is new technology from Alfa Laval and, for the owner, can realise up to 2% reduction in fuel costs. There is a 99 % reduction in volume of oily waste, with a minimal amount of solids for disposal ashore. No additional waste is generated. This virtually eliminates oil waste handling costs, and is an effective pre-treatment of water prior to discharge to the bilge water tank. There is a reduction in the CO_2 footprint, low fixed maintenance cost, 90% reduction in oily waste and sludge disposal costs, and a continuous mechanical warranty using the MSE concept.

On the installation side, there are smaller holding tank volumes giving increasing payload capacity. The compact modular design makes for installation flexibility, and it is easy to integrate with existing onboard systems.

Questions

Question time elicited some further interesting points.

The skid mount for the module version is about 2 m long. However, the heater unit, control unit and separator unit (which make up the module) can be installed separately if space is limited.

The continuous maintenance warranty is an agreement between Alfa Laval and the shipowner for $x per year for Alfa Laval to undertake the maintenance of the system. The competency of engineers on ships is not as high today as it used to be, and many items now have to go ashore for servicing.

The PureDry system also helps to lower the IMO Energy Efficiency Operational Index, which is another reason why many companies are looking seriously at it.

The dry waste produced has very low calorific value, cannot be burned on board, and must be disposed of ashore.

The vote of thanks was proposed, and the certificate and "thank you" bottle of wine presented, by Alan Taylor.

Phil Helmore

COMING EVENTS

NSW Section

The sixteenth SMIX (Sydney Marine Industry Christmas) Bash will be held on Thursday 3 December aboard the beautifully-restored *James Craig* alongside Wharf 7, Darling Harbour, from 1730 to 2130. This party for the whole marine industry is organised jointly by RINA (NSW Section) and IMarEST (Sydney Branch). Join your colleagues in the maritime industry and their partners for drinks and a delicious buffet meal on board the unique 19th century iron barque. Cost is $55 per head. Dress is smart casual, but absolutely no stiletto heels!

Those wishing to attend this Sydney Maritime Industry Christmas Party should purchase their tickets through www.trybooking.com/Booking/BookingEventSummary.aspx?eid=154314. Payment only accepted by Visa and Mastercard.

Alternatively, you may mail your details (including names of guests and your email address for confirmation of booking), together with your cheque, to the RINA (NSW) Treasurer, Adrian Broadbent, at 27 Manning St, Queens Park NSW 2022.

There is a maximum limit of 225 attendees on *James Craig* and we have had to turn away members and friends in previous years; so you are urged to book early.

Basic Dry Dock Training Course

DM Consulting's Basic Dry Dock Training is a four-day course which covers the fundamentals and calculations of dry docking. The next course in Australia will be held on 1–4 February 2016, in Melbourne.

The course begins with the basics and safety concerns, and progresses through all phases of dry docking: preparation, docking, lay period, and undocking. The course ends with a discussion of accidents and incidents.

It is designed to be relevant to dock masters, docking officers, engineers, naval architects, port engineers and others involved in the dry docking of ships and vessels. The course is presented through classroom lectures, student participation in projects, and practical application exercises. The course addresses the deck-plate level of practical operation needed by the dock operator and the universally-accepted mathematical calculations required to carry out operations in accordance with established sound engineering practices.

"The course was excellent, straight forward and comprehensive. Instruction was great, expected 'death-by-PowerPoint, but was pleasantly surprised. I am better acquainted with dry dock basics after the course and can trust the accuracy of the training based on the extensive experience of the instructors. Thank you! Very informative, very thorough."

Topics to be covered include:

- Basic dry docking community terminology
- Calculations
- Safe dry docking procedures
- Lay period
- Undocking evolutions
- Docking Plans
- Docking and undocking conferences
- Hull boards
- Vessel stability
- Incidents/accidents

"Fantastic. Really good course. Personally, I got a lot out of the course and will certainly recommend it to my work colleagues."

"Very informative. Subject matter which was dry, was taught without being boring. Class was great, learned a lot! Thank you."

Joe Stiglich, the course leader, is a retired naval officer, qualified NAVSEA docking officer and holds a master's degree from MIT in naval architecture and marine engineering. Responsible for over 250 safe docking and undocking operations, he currently runs a series of conference and training courses for personnel involved in all phases of the dry docking industry and acts as a consultant for ship repair companies.

For further information and to register please see www.drydocktraining.com.

AOG 2016

With a string of world-class Australian LNG projects making the transition from the construction to operational phase, it is timely that process control and automation technology will again feature highly when the annual Australasian Oil and Gas Exhibition and Conference (AOG) is staged in Perth from the 24 to 26 February 2016.

Celebrating its 35th year, AOG 2016 will feature a theme of *Collaboration* with over 100 experts from leading companies


AOG
2016
SAVE THE DATE
AUSTRALASIAN OIL & GAS
EXHIBITION & CONFERENCE
24-26 FEBRUARY 2016
PERTH CONVENTION EXHIBITION CENTRE
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providing input on how industry, government and other key stakeholders should continue to work closely together to reduce costs and improve productivity.

AOG thrives on the flood of attendees who visit the Perth Convention Exhibition Centre to meet with over 500 exhibiting companies from 25 countries at the Australasian Oil & Gas Exhibition and Conference.

The Royal Institution of Naval Architects is a conference partner for AOG 2016. The RINA has organised a conference stream for both days on fixed and floating offshore structures.

For more information on AOG 2016 visit www.aogexpo.com.au.

Pacific 2017 IMC

The next Pacific International Maritime Conference, held in conjunction with the Pacific International Maritime Exposition and the Royal Australian Navy's Sea Power Conference, will be held in Sydney on 3–5 October 2017 to coincide with Navy Week, and Pacific 2017 will be held at the brand-new Sydney Exhibition Centre at Darling Harbour.

The domain name of www.pacific2017.com.au has been registered and the website is parked.

Put these dates in your diary and, for further details, watch this space!

CLASSIFICATION SOCIETY NEWS

Global Marine Technology Trends 2030

The *Global Marine Technology Trends 2030* report released on 7 September indicates that:

- Momentum and capability for a significant evolution in ship design and operation is now building—the report presents design scenarios for commercial ships in 2030.
- By 2030 the fastest and most-radical impacts are likely to be felt in the development of naval ships and systems, where maritime autonomous systems are driving the biggest revolution in maritime security in over a century.
- Understanding the world's oceans is more essential than ever to secure the future of our planet.

Global Marine Technology Trends 2030 is the culmination of a collaborative project between Lloyd's Register, QinetiQ and the University of Southampton, looking at the future for commercial shipping—without which world trade would cease; for navies—so vital for security; and the health of the oceans—the vital resource which defines the future well-being of the planet.

In asking 'what's next', *GMTT 2030* is an aid to business, policy makers and society in trying to understand the future for the maritime industries and the oceans. Assessing 56 technologies and then focusing on 18 specific areas of technology, *GMTT 2030* builds on the scenario work in *Global Marine Trends 2030* and *Global Marine Fuel Trends 2030* to provide insight into the impact and—critically—the timescales of transformative technology.

LR was the lead partner on the commercial shipping parts of the report and focused on eight technologies which will transform commercial shipping. As LR's Marine Marketing Director, Luis Benito explains "The marine world in 2030 will be a connected and digital one, bringing closer integration between people, software and hardware in a way that could transform the way we operate. We know technology is changing our world and there is a great deal of overlap between technologies and how they combine will be important".

The report identifies two groups of technology drivers—those which will transform the ship design and build space—leading to advancement in ship building, propulsion and powering and the development of smart ships; and the technologies which drive safety, commercial and operational performance—advanced materials, big data analytics, communications, sensors and robotics.

The world, of course, wants to know what the impact of these drivers will be on different ship types. The report presents 'Technomax' scenarios for bulk carriers, tankers, container ships and gas carriers. The Technomax scenarios are not concept ships, but give an indication of the potential maximum technology uptake relevant to the four ship market sectors.

Tom Boardley, LR's Marine Director commented "Shipping is likely to evolve quickly now. That evolution is likely to be uneven but, while 2030 is not far away, we think that shipping is likely to have changed significantly".

The report may be downloaded at www.lr.org/gmtt2030.

LR Press Release, 8 September 2015

First Ethane-powered Ships Classed by BV

The first ethane-powered ship, *JS Ineos Insight*, the leading ship in a series of eight 27 500 m^3 multi-gas Dragon-class vessels being built at Sinopacific, China, for Denmark's Evergas, was named on 14 July. The new vessels configured for transport of ethane, LPG or LNG, with options for ethane, LNG and conventional diesel power, will be classed by Bureau Veritas.

"The ability to burn ethane as well as LNG to power these unique vessels is a major step forward in the use of clean fuels. It means that the vessels can use cargo gas during transits to provide a clean and clear commercial and environmental advantage," said Bureau Veritas' business development manager, Martial Claudepierre. "We have worked with Evergas and the Danish Maritime Authority to verify and ensure that the use of ethane is at least as safe as required by the IGC and will not impair the engine compliance with MARPOL Annex VI."

The Dragon vessels were originally designed with dual-fuel LNG/diesel power utilising two 1000 m^3 LNG tanks on deck powering two Wärtsilä 6L20 DF main engines with a total of 2112 kW power and two shaft generators with a total of 3600 kW power. The ability to also burn ethane was added to allow use of the cargo gas, as the vessels are destined initially for transport of ethane from the USA to the UK Ineos refineries.

Evergas, wholly owned by Greenship Gas and JACCAR Holdings, has a large newbuilding program of ethylene, ethane and LNG multi-gas carriers.

Claudepierre said "Using ethane required extra engine-room

ventilation and additional gas detection, plus modifications to the main engines including a lower compression ratio, different turbocharger nozzles and de-rating of the engine to cope with the lower knocking resistance of ethane. But the gains in not carrying an additional fuel, and in environmental performance from being able to burn clean fuel throughout the voyage, are significant."

MarineLink.com, 15 September 2015

Meeting of LR's Australian Technical Committee

The Australian Technical Committee of Lloyd's Register met on 3 September to consider proposed changes to Lloyd's Rules. Comments from the Australian Technical Committee will be considered, along with comments from other LR Technical Committees around the world, by Lloyd's Technical Committee in London in November, and the changes will be promulgated in 2016.

New Requirements for Stability Instruments on Tankers

New stability instrument requirements will apply to all tankers constructed (keel laid) on or after 1 January 2016 (1 July 2016 for gas carriers). These ships will be required to fit an approved stability instrument, capable of verifying compliance with intact and damage stability requirements.

Tankers constructed (keel laid) before 1 January 2016 (1 July 2016 for gas carriers) must also comply with the requirements (by confirming or upgrading existing equipment, or installing new equipment) at the first applicable scheduled renewal survey of the ship after 1 January 2016 (1 July 2016 for gas carriers under the IGC Code), but not later than 1 January 2021 (1 July 2021 for gas carriers under the IGC Code). Alternatively, owners and operators can apply to their flag administration for a waiver if their vessel is loaded in accordance with approved conditions and falls into one of the following categories:

- tankers that are on a dedicated service, with a limited number of permutations of loading so that all anticipated conditions have been approved in the stability information provided to the master in accordance with the relevant regulations;
- tankers where stability verification is made remotely by a means approved by the administration;
- tankers which are loaded within an approved range of loading conditions; or
- tankers constructed before 1 January, 2016 (1 July, 2016, for gas carriers), provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

The stability instrument must be approved by Lloyd's Register [*or other classification society*—Ed.] or the flag administration, taking into account the performance standards recommended by the IMO (Part B, Chapter 4 of the 2008 IS Code; Annex, Section 4 of the Circular MSC.1/Circ.1229; and the technical standards defined in Part 1 of the Circular MSC.1/Circ. 1461). The loading instrument should have a Document of Approval which clearly reflects this capability. The Lloyd's Register (LR) Program Installation Test certificate will serve this purpose if it clearly states that both intact and damage stability aspects are covered by the software.

If vessels require a new and/or upgraded stability software installation to comply with the latest requirements, the software should have a valid LR General Approval

Certificate clearly specifying 'Type 2' or 'Type 3' software. To avoid complications associated with developing suitable KG/GM limit curves and their potential restriction on operational capacity, we strongly recommend that Type 3 stability software is fitted on board.

The new requirements have been introduced to MARPOL Annex I and the IBC, IGC, BCH and GC Codes by IMO Resolutions MEPC.248(66), MSC.369(93), MSC.370(93), MSC.376(93) and MSC.377(93)), respectively, to make the provision of a stability instrument mandatory on board all oil tankers, chemical tankers and gas carriers. Vessels are still required to carry approved stability documentation, regardless of whether they are fitted with an approved stability instrument or not.

International Oil Pollution Prevention Form B certificates for oil tankers and IBC/BCH and IGC/GC certificates of fitness for chemical tankers and gas carriers will be required to reflect the provision of an approved stability instrument on board in accordance with the new regulations, or, alternatively, the applicable waivers granted by the administration.

Owners and operators must ensure that their vessels are fitted with compliant stability instruments by the relevant compliance date, or, if appropriate, apply to the vessel's flag administration for a waiver.

Lloyd's Register, Class News 17/2015 (re-issued)

ABS Release World's First Guide for SOx Scrubber Ready Vessels

ABS has published the ABS *Guide for SOx Scrubber Ready Vessels* to support members and clients in preparing newbuilds for future outfitting with a SOx exhaust gas cleaning system (EGCS).

Supporting the world's first classification notation for SOx Scrubber Ready Vessels, the ABS *Guide* formalizes the process for clients who wish to plan for retrofit of a SOx scrubber at a future date by providing a detailed review and approval and an associated notation.

The SOx Scrubber Ready notation is in addition to ABS EGCS notations which may be assigned for vessels fitted with an exhaust emission-abatement system, including SOx scrubbers, selective catalytic reduction systems and exhaust-gas recirculation arrangements for NOx emission control, in accordance with the ABS *Guide for Exhaust Emission Abatement*.

"The decision to build a new ship or retrofit an existing one is not simple, due to uncertainty with the entry into force of the 0.5% global sulphur limit and cleaner fuel alternatives such as LNG," says ABS Chief Technology Officer and Senior Vice President, Howard Fireman. "The new ABS SOx Scrubber Ready notation provides a unique approach to future-proof assets, to implement cost-effective retrofits and to demonstrate a commitment to environmental performance."

In addition to the new ABS *Guide for SOx Scrubber Ready Vessels* and *Guide for Exhaust Emission Abatement*, ABS has published the ABS *Advisory on Exhaust Gas Scrubber Systems*. These guides and advisory are available at www.eagle.org.

ABS Grants AIP for MES FPSO Design

ABS has granted Mitsui Engineering & Shipbuilding Co. Ltd (MES) approval-in-principle (AIP) for a floating production, storage and offloading (FPSO) vessel design and an epoch-making construction concept.

This work is the result of an ABS/MES joint development project which began in March 2015. The "noah-flex modular design" for the FPSO and the flexible construction procedure, "noah-flex modular construction," were granted AIP on 15 September.

"ABS is working with industry to develop and employ new technologies," says ABS Chairman, President and CEO, Christopher Wiernicki. "To effectively support class of the future, ABS has to provide the services which the industry needs to make adjustments as operating conditions and markets change. Granting AIP to new technologies is an essential element of that future."

"ABS is one of the world's leading classification societies with excellent technology and a wealth of know-how in the offshore industry," says MES General Manager, Dr Taketsune Matsumura. "MES recognizes that ABS is our dependable partner and plays an indispensable role in developing and realizing such an epoch-making concept as our "noah-FPSO hull."

The noah-flex modular construction processes consists of multiple steps which ttake place in parallel to shorten the construction time efficiently, with keel laying marking the commencement of construction. The first step of the project is FPSO design and hull construction, including propulsion and relevant machinery equipment/systems, which will be carried out by MES in Japan, while construction of the oil-storage component takes place at another yard, outside Japan, for example. Following this process, the topside facilities will be subsequently/simultaneously fabricated in a different, or the same, shipyard and installed on the elongated hull, after which the completed FPSO will move to the specified operation site for hookup and commissioning.

The FPSO design will be reviewed for compliance with the ABS Rules and applicable international/national regulations to make sure that the unit is in full compliance, particularly when executing transits from one shipyard to another during construction.

"ABS recognizes that working with industry to advance technology is critical," says ABS Special Advisor, Ken Tamura. "Engaging in this project with Mitsui provided ABS, with the opportunity to help shape the future of vessel construction."

ABS to Class Maersk's Largest Boxships

ABS has been selected to class 11 ultra-large containerships (ULCs) for Maersk Line A/S of Denmark.

The carrier, which is among the world's largest, ordered the 19 630 TEU vessels from Daewoo Shipbuilding & Marine Engineering (DSME) of South Korea last month in a deal which includes options to build up to six additional vessels.

ABS was chosen to class 20 of the Triple-E containerships which Maersk ordered from the same shipyard four years ago. While the new additions will be slightly larger, the owner indicated that energy efficiency, economy of scale and the environment are still central considerations.

"ABS is pleased that the Maersk Group has expressed its continued confidence by classing these innovative ships with us," says ABS Executive Vice President and Chief Operating Officer, Tony Nassif. "ABS offices worldwide, working in unison, are providing support and analysis for Maersk in the latest standards and international codes, including the energy-efficiency standards measured and mandated by the IMO."

Much like the first generation of Triple-E containerships, this second order will allow the carrier to further increase operational efficiencies over and above those of other vessels involved in the Asia-to-Europe trade, while maintaining its market share in line with container trade volumes.

The newbuildings, which will be the largest containerships in the Danish carrier's fleet, are due for delivery between April 2017 and May 2018.

ABS has served the containership segment for more than 50 years. From ultra-large to LNG-powered, as a leading provider of classification services to some of the largest and most sophisticated containerships ever built, it should come as no surprise that the organisation's reputation as a pioneer in this sector continues to this day.

Craig Hughes

GENERAL NEWS

Chinooks Commence Trials with HMAS *Canberra*

The RAN's Aircraft Maintenance and Flight Trials Unit, along with C Squadron, 5 Aviation Regiment, has conducted a 'quick look' trial of the CH-47D Chinook onboard the Navy's Flagship, HMAS *Canberra*. The trials were conducted over a week with preliminary work being conducted at HMAS *Albatross* and the flying trials conducted at sea on 20–21 October 2015.

The Chinook helicopter conducted a series of evolutions to HMAS *Canberra*'s flight deck, including launch and recoveries along with an assessment of external load operations known as vertical replenishment or VERTREP. An assessment was also made of aircraft lashing schemes and refuelling procedures.

This trial was the precursor for a full first-of-class flight trial planned for the CH-47F in late 2016. The CH-47D and CH-47F are both operated by C Squadron from Townsville in Queensland.

Commander Air, HMAS *Canberra*, CMDR Paul Moggach, said that the trial represented another milestone in operational capability for the ship.

"We are already authorised for deck operations with MRH-90 Taipan and S-70B-2 Seahawk helicopters, and the Chinook activity this week has further expanded our knowledge," he said.

"We look forward to operating with Army helicopters in support of our amphibious roles."

The outcome of the trial is to provide a limited CH-47D operating envelope to the Landing Helicopter Dock or amphibious assault ship.

New Icebreaker for Australia

On 29 October, the Australian Government provided the first look at Australia's new icebreaker, showcasing a modern, sophisticated ship which will offer scientists unprecedented and extended access to the Southern Ocean and Antarctica. The once-in-a-generation investment by the Australian Government will form the centrepiece of Australia's Antarctic presence and influence the shape of Australia's Antarctic programme for decades to come.

A CH-47D Chinook about to land on the deck of HMAS *Canberra* during first-of-class flight trials in Jervis Bay (RAN photograph)

An impression of Australia's new icebreaker
(Image Damen/DMS Maritime/Knud E. Hansen A/S, courtesy Australian Antarctic Division)

The new, custom-built icebreaker will be uniquely tailored to meet Australia's needs. It will be faster, larger, stronger and offer increased endurance compared with the ageing *Aurora Australis* which has been battling the stormy Southern Ocean since 1989.

The new ship provides a modern platform for marine science research in both sea ice and open water.

A multi-beam bathymetric echo sounder will enable seafloor mapping, while portable and flexible science laboratories will offer scientists space to conduct cutting-edge research.

The procurement represents the single biggest investment in the history of Australia's Antarctic programme, with additional funding committed by the Australian Government to modernise shore-side infrastructure and equipment at Australia's Antarctic stations and in Hobart.

Reliable access to Antarctica is essential to Australia's physical presence and scientific research, and an icebreaker forms the backbone of our Antarctic operations.

For decades *Aurora Australis* has been an icon in Hobart. The new ship will also be home ported in Hobart, further demonstrating Tasmania's role as the gateway to East Antarctica.

The new, larger and more-sophisticated multi-purpose icebreaker will create greater opportunities for Tasmanian businesses to provide a range of support services over the 30-year lifespan of the vessel.

Australian company DMS Maritime Pty Ltd has been selected as the preferred tenderer to undertake the ship design and building process, and will then operate and maintain the icebreaker.

The Department of the Environment and DMS Maritime have recently commenced formal contract negotiations.

Subject to successful contract negotiations, the icebreaker will be built by Damen Shipyards, a highly-reputable global shipbuilder which has produced a broad range of bespoke vessels including scientific, hydrographic, naval and ice class ships.

The new icebreaker is expected to be commissioned in October 2019.

The general particulars of the new ship are:

Length OA		156 m
Beam (max)		25.6 m
Draught (max)		9.3 m
Displacement		23 800 t
Icebreaking		1.65 m at 3 kn
Speed	(maximum)	over 16 kn
	(economical)	12 kn
Range		over 16 000 n miles
Endurance		90 days
Fuel capacity		4.234 ML
Cargo fuel		1.9 ML
Container capacity		96 TEU
Cargo dwt		1200 t
Passengers		116

Six New Incat Ferries for Sydney Harbour

In September, Incat Tasmania's Hobart Shipyard was awarded a contract to build six new ferries to operate on Sydney's Inner Harbour. Announcing the result of a competitive tender process, the NSW Minister for Transport, Andrew Constance, said "the ferries are a major step forward in the NSW Government's plans to modernise and expand the ferry network. "

Externally, the new vessel is a traditional design to look similar to the Sydney First Fleet vessels; however, the 35 m, 400 passenger boats have greater capacity than the current fleet. The interior will be more spacious with comfortable inside seating, outdoor viewing areas, a large walk-around deck and additional features for passengers; including wi-fi access and real-time journey information, and charging stations for electronic devices.

The Sydney ferries will service commuter and tourist travel on the inner-harbour routes from Watsons Bay in Sydney's east to Cockatoo Island in the west, stopping at the new Barangaroo wharf.

The Incat team's first task is to take the concept design to detailed construction drawings and vessel models, with construction of the first ferry to start early in 2016. The six will be delivered progressively from late 2016 and throughout 2017.

An impression of Sydney's new ferries to be built by Incat Tasmania
(Photo courtesy Transport for New South Wales)

The Incat Tasmania Pty Ltd shipyard at Prince of Wales Bay in Hobart has around 250 staff. The yard's Managing Director, Simon Carter, said "This is a great opportunity for Incat's highly-skilled and experienced workforce to participate in the construction of ferries for the iconic Sydney fleet. An order such as this, where six identical vessels are to be built, is welcomed by the existing staff and provides an excellent opportunity for training new personnel."

Incat has recently completed two fast ferries for the London operator Thames Clippers, which entered service in October. Four fast ferries, two 24 m and two 33 m boats, are also under construction for Sydney company Manly Fast Ferry.

Incat, renowned internationally for design and construction of high-quality environmentally-friendly and efficient vessels, has built more than 70 vessels, with ships in service around the world. With three vehicle ferries delivered since 2013 to South America, Europe and the Far East, a fast crew boat to Azerbajain, two passenger ferries to the UK, and 10 fast ferries on order in Australia, Incat is the world's largest fast-ferry builder by both quantity of ferries (ordered and delivered) and revenue.

Incat Secures Large Ship Order for Denmark

Incat Tasmania announced on 5 October that it had secured a contract for the construction, delivery and long-term charter of a large fast vehicle ferry for Danish company Mols-Linien A/S. The ferry will be the fourth Incat vessel in the Mols Linien fleet.

Incat's Hobart shipyard will commence work on construction of the wave-piercing catamaran immediately, with delivery scheduled for the first quarter of 2017.

Incat Chairman, Robert Clifford, in Copenhagen, Denmark, at the Interferry Conference said "A large ship order to a repeat customer is proof positive of the quality and reliability of the vessels our team build in Tasmania. This is the third Incat ship that Mols Linien has added to their fleet in a period of just four years".

Incat Tasmania Managing Director, Simon Carter, said "We have been working on the project for some time and although the design team still have some finer details to complete, construction will commence immediately. The 250 production staff are currently building four passenger vessels for Manly Fast Ferries, with another six-boat order for Sydney Ferries to commence in 2016. This new large ship order will secure work for an expanded workforce for at least a further two years".

The newbuild super ferry, Incat hull number 088, will be named *KatExpress 3*. The fast ferry will be an upgraded and more customer-friendly version of near sister-ship vessels *KatExpress 1* (Incat hull 066) and *KatExpress 2* (Incat 067). The new fast ferry can take up to 1000 t of cargo, equivalent to up to 1000 passengers and 417 cars. Like *KatExpress 1* and *KatExpress 2*, the new fast ferry will carry trucks, campervans, motorcycles and bicycles.

With *KatExpress 1* and *2* added to their fleet Mols Linien has increased the capacity on the Kattegat by 172% since 2012. *KatExpress 3* is expected to commence operation on the route between Aarhus and Odden and the route between Ebeltoft and Odden in late May 2017.

KatExpress 3 is likely to replace the company's smallest ferry *Max Mols*, an Incat 91m vessel (Incat hull 048) built in 1997, and this will mean that the company can transfer up to an additional 400 000 cars a year.

In a statement to the Danish Stock Exchange, Mols-Linien announced that, since the inauguration of the first super ferry, they have increased the number of passenger car units by 58 percent in the period from 2011 to 2014. The company in 2011 transferred 719 703 passenger car units, and 1 138 315 passenger car units in 2014. Passenger numbers in the same period increased by 33 percent.

Veteran Warship Decommissioned

Australia has farewelled a Royal Australian Navy ship which has served the country for over three decades in a ceremony on Sydney Harbour on Saturday 7 November.

The Governor-General, His Excellency General the Honourable Sir Peter Cosgrove, AK MC (Retd), together with the Minister for Defence, Senator the Hon Marise Payne, and Chief of Navy, Vice Admiral Tim Barrett, AO, CSC, RAN, attended the decommissioning of HMAS *Sydney* at her home port of Garden Island, Sydney.

Minister Payne paid tribute to the service of ship's company past and present.

"It is important to acknowledge the hard work and dedication of the current and former crews who have called *Sydney* home," Minister Payne said

The Australian White Ensign was lowered from the ship for the last time, and handed to Commanding Officer, Lieutenant Commander David Murphy, RAN, as is the tradition for Navy during decommissioning ceremonies.

Minister Payne said that the fourth Royal Australian Navy ship to bear the name *Sydney* had a proud history spanning over 32 years.

"The ship has served Australia with distinction, including during active service to Kuwait in 1991, East Timor in 1999, and subsequent deployments to the Middle East, earning a Meritorious Unit Citation during the First Gulf War," Minister Payne said.

During the conduct of maritime operations spanning the globe, *Sydney* steamed 959 627 n miles across operations in locations including Fiji, Papua New Guinea and Solomon Islands.

"More recently *Sydney* has been tasked with border-protection operations and major coalition exercises.

"Her last mission, which concludes in December this year, is the important harbour-training-ship role providing the vital technical training which our next generation of sailors needs for the new capability on the Royal Australian Navy's horizon," Minister Payne said.

Sydney was built at the Todd Pacific Shipyards in Seattle, Washington, USA, and commissioned in 1983. Her commissioning crew trained there for just over 12 months before sailing for Australian waters. *Sydney* is being decommissioned to make way for the Hobart-class air-warfare destroyers, which will provide Australia with an improved war fighting capability.

HMAS *Ballarat* ASMD Milestone

On 2 September, HMAS *Ballarat* completed her in-dock production activities associated with the Anti-Ship Missile Defence (ASMD) upgrade. *Ballarat* has now been returned to the material control of the Royal Australian Navy and will commence setting to work systems and sea trials.

Ballarat was undocked at the BAE Systems Henderson (WA) shipyard after 56 weeks on the hardstand as part of the ASMD upgrade and vital maintenance work, involving some 600 000 hours by 250 employees and 30 local subcontractors.

Under the ASMD program, the RAN is receiving a world-leading defence capability. The combat-management system is being upgraded and an infrared search-and-track system is being introduced as well as a phased-array radar and dual navigation radar system. While the ships are on the hard stand for the ASMD upgrade, other complex engineering and structural changes are being made to the frigates. These include enclosing the quarterdeck and modifications to accommodate the MH-60 Romeo naval helicopters.

The BAE Systems Henderson facility will continue to

The ship's company of HMAS *Sydney* on parade during her decommissioning ceremony at Garden Island, Sydney, on Saturday 7 November 2015; HMAS *Warramunga* is astern of *Sydney*
(RAN photograph)

A bird's-eye view of NUSHIP *Brisbane* under construction at ASC in Adelaide. *Brisbane* is now about 68% complete (Photo courtesy AWD Alliance)

focus on the ASMD upgrade program. Work on HMAS *Parramatta* is continuing, and HMAS *Toowoomba* (the seventh ANZAC frigate to enter the ASMD program) was docked in October.

Director of Maritime, Bill Saltzer, praised the efforts of the integrated delivery team at Henderson: "BAE Systems, together with our Anzac Alliance partners, have successfully implemented the ASMD capability and other significant engineering changes on HMAS *Perth*, *Arunta*, *Anzac* and *Warramunga*. Productivity has improved significantly from ship to ship, demonstrating the value of continuous activity. BAE Systems' success as prime contractor and platform system integrator also demonstrates the importance of the involvement we had in the original design and construction of the Anzac ships. The work being undertaken at our Henderson yard is further testament to the skills and capabilities available in our BAE Systems Maritime business, and demonstrates the essential role we play in supporting the Australian Defence Force."

The work was completed through the Anzac Ship Integrated Material Support Program Alliance comprising BAE Systems, Saab Systems and the Department of Defence Capability Acquisition and Sustainment Group (CASG). The program is on-track to be completed in 2017 and will include upgrades to a further three vessels, including HMA ships *Parramatta*, *Toowoomba* and *Stuart*.

Austal Launches 72 m HSSV for Oman

On 22 October, Austal launched the first of two 72 m high-speed support vessels (HSSVs) being built for the Royal Navy of Oman (RNO.

Hull 390 — the future RNOV *Al Mubshir* — was successfully launched after 13 months of construction and fitting out at the company's Henderson, Western Australia, shipyard.

Austal's Chief Executive Officer, Andrew Bellamy, said that the on-schedule launching of the first HSSV demonstrates Austal's proven capability to design, construct and support large, multiple naval vessel programs, locally and globally, successfully.

Mr Bellamy commented "From our defence portfolio, Austal is currently contracted to deliver ten 127 m frigate-sized littoral combat ships and ten 103 m expeditionary fast transport (EPF) vessels to the United States Navy — as well as two OPV-sized 72 m high-speed support vessels, here in Western Australia, for the Royal Navy of Oman."

"Our track record here in Australia and overseas clearly supports Austal's strong proposition that we can effectively and efficiently deliver the Australian Government's future frigate and offshore patrol vessel programs," Mr Bellamy added.

Based on the proven expeditionary fast transport (EPF) platform — previously known as the joint high-speed vessel (JHSV) — the HSSV offers a range of capabilities to support naval operations, including helicopter operations, rapid deployment of military personnel and cargo, search-and-rescue operations, humanitarian aid and disaster-relief missions.

Austal was awarded the $US124.9 million contract for the design, construction and integrated logistics support of the two HSSVs in March 2014 and construction commenced in August 2014.

This first HSSV will now complete final fitting out before sea trials, prior to delivery to the RNO early in 2016. The second HSSV is under construction and is on schedule for completion in mid-2016.

The future RNOV *Al Mubshir* afloat for the first time
(Photo courtesy Austal)

Austal USA Awarded Procurement Contract

On 29 October, Austal announced it had been awarded a $US53.5 million contract to procure long-lead time materials for the eleventh expeditionary fast transport (EPF 11), formerly known as the joint high-speed vessel, for the US Navy.

Chief Executive Officer, Andrew Bellamy, said that the contract award was an important step on the critical path to a new shipbuilding contract.

"It is timely that the US Navy has directed Austal USA to move forward with the procurement of the long-lead items for EPF 11. We can now anticipate finalisation of a shipbuilding contract for EPF 11 in the coming months."

"Costs incurred will be reimbursed but no profit will be recognised prior to execution of the shipbuilding contract," Mr Bellamy said.

The award covers materials including main propulsion engines, generators, waterjets, main reduction gears and other long-lead time items.

The Austal USA-built EPF 6 , the future USNS *Brunswick,* during her launching in May. The ship completed acceptance trials on 23 October and will be delivered to the US Navy later this year
(Photo courtesy Austal)

New Sydney Harbour Ferries

Transport for NSW (TfNSW) awarded a contract to One2three Naval Architects as consultants to develop, in conjunction with TfNSW and various stakeholders, the concept design for the new Sydney Ferries 400-passenger inner-harbour ferries.

The concept design was released with the tender for construction of six new vessels and, following a competitive tender process, Incat Tasmania was selected and subsequently awarded a design-and-construct contract for the provision of six new inner-harbour ferries. Incat Tasmania will now be tasked with developing a construction design for the ferries for TfNSW's approval prior to construction commencing in the first quarter of 2016.

The contract with One2three Naval Architects remains in place for the provision of consultancy services and it is anticipated that One2three will continue to work closely with TfNSW during the design, construction and implementation phrases of the project.

Further details can be found on the TfNSW website, www.transport.nsw.gov.au/projects-sydneys-ferry-fleet.

Steve Quigley

Wavelength 4 from Incat Crowther

Incat Crowther has announced the delivery of *Wavelength 4*, a 19m catamaran tour vessel claimed by its operator to be "the cleanest tour vessel on the Great Barrier Reef". Built by Aluminium Marine in Queensland, *Wavelength 4* features Incat Crowther's efficient hullform and boasts numerous environmental features. The green approach was practical, focussing on a low environmental cost of producing and operating the vessel rather than emerging technologies.

In addition to the reduction in fuel usage which comes with the hullform, the vessel utilises LED lighting and solar panels. The Yanmar engines are Tier 2 rated and among the cleanest-burning engines available. The vessel operates on the basis of zero emissions whilst out on the reef, with the generators not required. This is aided by increased natural ventilation.

The toll of production was lowered by the implementation of solar power at the yard, local build to reduce delivery distance, and use of recyclable materials in addition to the elimination of ant–fouling paint.

The result of a collaborative development effort between Incat Crowther, Wavelength Cruises and Aluminium Marine, *Wavelength 4* aims to create an unparalleled customer experience. This experience starts from the moment the passengers board the vessel, where they are greeted with a large aft diving deck, complete with a lifting platform. When lowered, this platform provides a safe, stable and comfortable stepped entry into the water.

Forward of the aft deck are two toilets, stairs to the upper deck and the main-cabin door. Inside the main cabin, passengers are greeted by a large amenity space, including change rooms, galley and servery, and photo station. Forward of this space is a saloon with 38 lounge seats, in a bright, airy and relaxed environment.

Upstairs, the customer experience continues with lounges arranged around the central control position, offering interaction with the captain and commanding forward views. 44 seats are arranged on the upper deck, in a mix of inside, covered and uncovered configurations.

Wavelength 4 is powered by twin Yanmar 6HYM-WET main engines, delivering 478 kW each. She is capable of a maximum speed of 29 knots.

Principal particulars of *Wavelength 4* are

Length OA		19.6 m
Length WL		18.5 m
Beam OA		6.00 m
Depth		2.20 m
Draft	(hull)	0.95m
	(propellers)	1.50 m
Passengers		45
Crew		5
Fuel oil		2400 L
Fresh water		380 L
Sullage		380 L
Main engines		2×Yanmar 6HYM-WET each 478 kW @ 2150 rpm
Propulsion		2×five-bladed propellers
Generator		1×Mase I.S.7 6.7 kW 50 Hz
Speed	(service)	25 kn
	(maximum)	29 kn
Construction		Marine-grade aluminium
Flag		Australia
Class/Survey		NSCV Class 1C

Stewart Marler

Wavelength 4 on trials
(Photo courtesy Incat Crowther)

Wheelhouse on *Wavelength 4*
(Photo courtesy Incat Crowther)

Main cabin on *Wavelength 4*
(Photo courtesy Incat Crowther)

63 m Monohull Passenger Ferry from Incat Crowther

Incat Crowther has been commissioned to design a 63 m monohull passenger ferry to expand the operation of a Central American operator.

The main deck features a large cabin, hosting 286 first-class seats, 20 lounge seats, and four accommodation seating areas for people with a disability. The cabin also features a children's play area with surrounding seating. The aft deck features a cargo room with cargo-loading gates able to fit a portable conveyor belt for efficient loading and unloading. The aft deck also features two rest rooms, for men and women, as well as a third for people with a disability. The main deck allows four passenger-loading stations.

The mid deck features a cabin hosting 144 first-class seats and 32 lounge seats. Forward of the cabin is the raised wheelhouse with wing control stations port and starboard. Aft of the cabin is a spacious deck which offers 112 exterior seats. A mini-bar is located in the centre of the arrangement, with a stage for entertainment behind the cabin. The upper deck provides a large observation area including 36 exterior seats.

The vessel is powered by five MTU 16V400M63L engines equipped with ZF-7650 gearboxes and propelled by five Hamilton HM-811 jets. Two 150 ekW generator sets provide the vessel with electricity and a 149 kW bow thruster allows for manoeuvrability and stationing. A service speed of 37 kn and capacity for 650 passengers will provide efficient transportation.

Starboard bow of 63 m monohull passenger ferry
(Image courtesy Incat Crowther)

The vessel is another example of Incat Crowther's diverse product offering, and their ability to design an efficient vessel customised to an operator's needs.

Principal particulars of the new vessel are

Length OA	62.4 m
Length WL	55.9 m
Beam OA	10.5 m
Draft (hull)	1.80 m
Depth	4.25 m
Passengers	650
Crew	8
Deadweight	85 t
Deck Cargo	10 t
Fuel oil	25 000 L (day) 50 000 L (long range)
Fresh water	1500 L
Waste oil	1500 L
Main engines	5×MTU 16V4000M63L each 2240 kW @ 1800 rpm
Gearboxes	5×ZF760
Waterjets	5×Hamilton HM-811
Bow Thrusters	1×149 kW
Generators	2×150 ekW 60 Hz
Speed (service)	37 kn
(maximum)	40 kn
Construction	Marine-grade aluminium

27 m Catamaran Passenger Ferry from Incat Crowther

Incat Crowther has been commissioned to design a catamaran passenger ferry to be operated by Cataferry in Malaysia. The main deck features a full-width cabin accommodating 151 passengers. This area includes interior seating, a cargo luggage area, locker rooms for switchboards, and an entertainment bar. Aft of the cabin features three rest rooms and a luggage room to hold cargo. A swim deck is featured below, on the aft portion of the main deck.

Forty passengers can be accommodated on the mid deck within the cabin, and thirteen can be seated aft of the cabin outside. Forward of the cabin is the wheelhouse, including two captain's chairs and a chart table. The port and starboard sides feature wing control stations.

The vessel is propelled by two 1.016 m diameter fixed-pitch propellers powered by twin Caterpillar C32 ACERT engines. Two Caterpillar C4.4 generators supply electricity to the vessel.

Incat Crowther is pleased to provide Cataferry with a quality passenger ferry design, leveraging on decades of experience and expertise in the passenger ferry industry

Profile of passenger ferry for Catferry
(Image courtesy Incat Crowther)

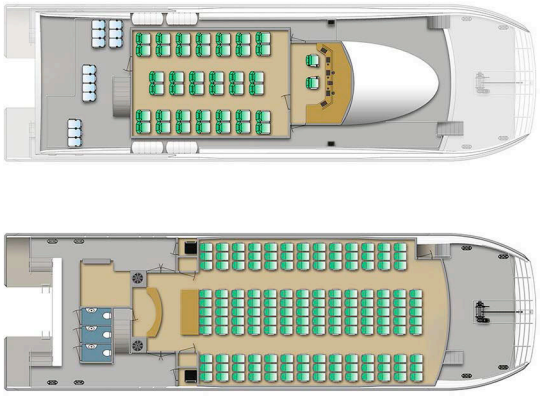
Principal particulars of the new vessel are

Length OA		27.5 m
Length WL		26.5 m
Beam OA		8.00 m
Depth		2.80 m
Draft	(hull)	1.00 m
	(propeller)	1.30 m
Passengers		191
Crew		6
Fuel oil		10 000 L
Fresh water		1000 L
Sullage		1000 L
Main engines		2×Caterpillar C32 ACERT B-Rating each 970 kW @ 2100 rpm
Propulsion		21.016 m diameter fixed-pitch propellers
Generators		2×Caterpillar C4.4
Speed	(service)	28 kn
	(maximum)	30 kn
Construction		Marine-grade aluminium
Flag		Malaysia
Class/Survey		Bureau Veritas

Zach Dubois

John Oxley Restoration Documentation from John Butler Design

John Butler Design has partnered with the Sydney Heritage Fleet which is undertaking the restoration task of *John Oxley*. This project will see the early-20th Century coastal vessel restored to its former glory to preserve history, and share that history with future generations of Australians.



General arrangement of main and mid decks of passenger ferry for Catferry
(Image courtesy Incat Crowther)

Much of the naval architectural documentation for the ship has been lost over the years, so JBD is working to reproduce it, starting with the lines plan and stability model of the hull. The vessel requires modern machinery and safety equipment to comply with survey requirements. This stability model will enable advice to Sydney Heritage Fleet on what impacts this equipment and their modifications will have on the vessel when launched.

HMAS *Choules* Side-door Ramp

The hydraulic cylinders which lower and raise the side-door ramp of HMAS *Choules* required maintenance. In order to undertake this work the ramp had to be supported by another

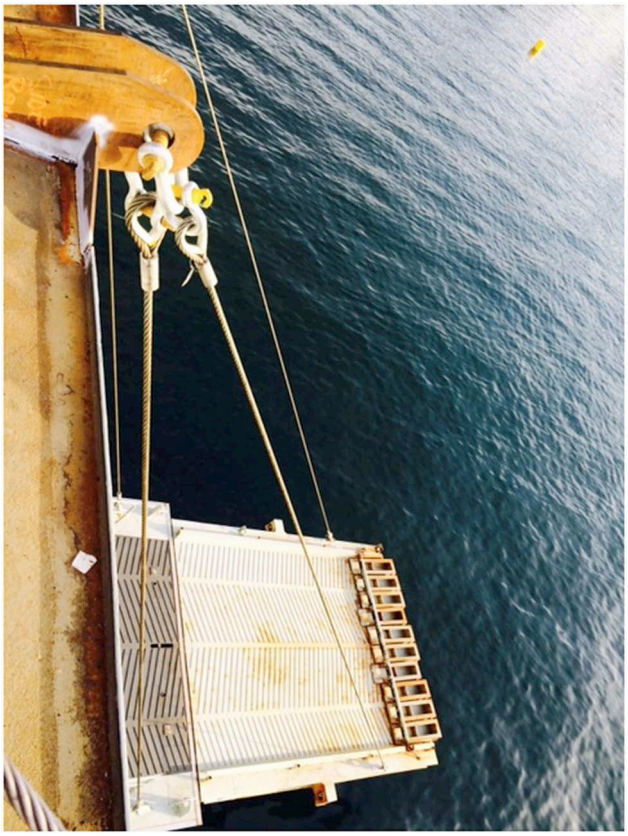
John Oxley progress
(Photo courtesy John Butler Design)

means. Whilst maintenance was undertaken, the ramp was supported by cables attached to lugs on the ship. The existing lugs on the inner section of the ramp were utilised and new lugs were installed on the main deck of the ship and the outer section of the ramp.

A finite-element model of the ramp, a portion of the ship's structure which supports the ramp, the new lugs, and the ship's structure surrounding these lugs, was generated using Strand 7 FEA software. The stresses were determined and then compared with the allowable stress.

The lugs were load tested prior to use. As these loads were greater than the expected operational loads, the model was also analysed for these cases to ensure that no damage would occur to the ship's structure during load testing.

Manufacturing details and installation drawings for the new lugs were also provided



Side-door ramp on HMAS *Choules* under test
(Photo courtesy John Butler Design)

Outboard-motor cradle
(Photo courtesy John Butler Design)

Outboard-motor Cradle from John Butler Design

John Butler Design developed an innovative solution for the lifting and transportation of outboard motors for use by navy personnel during deployment. Previously, four personnel were required to manually lift an outboard motor off a vessel, and place it into the transport cradle. The newly-developed outboard-motor cradle reduced the personnel required from four down to one, and replaced the manual lifting task with a chain hoist to reduce the strain on personnel. Provision was also made for battery and fuel-tank storage on the cradle.

The cradle was designed to be fabricated in aluminium to ensure that it was light enough to use single-handedly. A 3D model of the cradle and a finite-element assessment were prepared for the cradle, analysing the lifting, wheeling and dynamic transport forces to which the cradle will be subjected. The model ensured accuracy in the production drawings which allowed Griffin Marine Services to fabricate the cradles.

The cradles satisfactorily passed the load testing requirements, and exceeded the expectations of the end operators.

John Butler

Cruising

After the winter quiet, with only *Pacific Jewel, Pacific Pearl, Sun Princess* and *Carnival Spirit* working out of Sydney, the summer cruise season got under way early with visits to Sydney by *Dawn Princess* on 18 September and *Diamond Princess* on 29 September. These were followed in October by visits by all these vessels plus *Radiance of the Seas, Carnival Legend, Golden Princess, Volendam, Celebrity Solstice* and *Noordam*. November moved into a higher gear, with return visits by these vessels plus Voyager *of the Seas* and *Costa Luminosa.* Vessels berthing regularly at the Overseas Passenger Terminal at Circular Quay is a sure sign that the summer cruise season is under way.

Phil Helmore

Costa Luminosa at the Athol Bight buoy in Sydney on Friday 6 November with an impressive storm approaching from the south
(Photo John Jeremy)

NUSHIP *Adelaide* passing her sister ship HMAS *Canberra* to berth at Fleet Base East on her arrival in Sydney on 30 October. *Adelaide*, the second of the RAN's new LHDs, will be commissioned in early December
(RAN photograph)

NSCV Help Tools

On the NSCV website there is a number of tools available for download to help make life easier for naval architects.

Visit www.amsa.gov.au/domestic/standards/national-standards and, in the Assistance/Tools column, you will find various tools, including a propeller-shaft calculator, required equipment lists for various classes of vessel and areas of operation, a fast-craft calculator, etc.

Phil Helmore

Grandfathering Arrangements under the National System

What are the responsibilities of a surveyor when conducting a periodic survey on a grandfathered vessel?

As an accredited surveyor, you must confirm that a vessel and its safety equipment comply with the requirements set out in that vessel's certificate of survey (CoS), or in any other pre-National System requirements.

The National Law sets out general safety duties on accredited surveyors, and requires that a person who designs, commissions, constructs, manufactures, supplies, maintains, repairs or modifies a domestic commercial vessel (DCV) or marine safety equipment that relates to such a vessel must:

- ensure, so far as reasonably practicable, that the vessel or equipment is safe if used for a purpose for which it was designed, commissioned, constructed, manufactured, supplied, maintained, repaired or modified, as the case may be; and
- either carry out, or arrange the carrying out of, such testing and examination as may be necessary, or ensure that such testing and examination has been carried out.

It is your role to provide a recommendation to the National Regulator about the vessel's compliance with the applicable standards. Recommendations are made via a State or Northern Territory Marine Safety Agency (MSA), subject to the above duties, and based on the relevant requirements applicable to a particular vessel.

Survey options for existing vessels under grandfathering arrangements

Vessels under grandfathering arrangements may be surveyed against either the:

- survey arrangement that applied to the vessel before the introduction of the National System; or
- National Standard for Administration of Marine Safety (NSAMS) system.

If an owner has chosen to use NSAMS as their survey regime, then it is important to remember that certain aspects of the survey will not differ from the system used before the introduction of the National System. For example, where a vessel is due for its five-year renewal survey, the lightship test will be the same test the vessel previously required (i.e. if it did not need lightship verification under its old certificate, then it is not needed under its new certificate).

What if changes are made to the vessel or the way it operates?

AMSA or an MSA will consider the change to see whether it impacts the grandfathering arrangements.

Generally, it is the owner's responsibility to inform AMSA or a State or Northern Territory MSA if they intend to make changes to their vessel, where it operates, or the type of operation for which the vessel is used. However, if you have reason to believe that the vessel has changed, or the

conditions of grandfathering may no longer apply, you should either:

- inform the owner accordingly so they can take the matter to AMSA or an MSA for review and consideration; or
- directly inform AMSA or the MSA.

As the review is risk based, it allows for every individual situation to be considered (at which point your input may be requested). This may result in the vessel continuing as it was, having conditions added to the CoS and/or certificate of operation, or in some cases losing its grandfathered arrangements.

Where can I find more information?

For further information:

- call AMSA Connect 02 6279 5000; or
- email National.system@amsa.gov.au

Reminder to Attested Marine Surveyors

If you are an attested marine surveyor and you intend to apply for accreditation under the National Law Regulation, then remember to submit your application before 31 December 2015.

If you submit your application after this date, then you will have to undergo the full assessment process, including attendance at a panel interview.

New Version of the National Standard for Commercial Vessels — Part B

A new version of the National Standard for Commercial Vessels (NSCV) — Part B is now available and commences on 24 October 2015. It provides definitions used across the National Standards and specifies how these standards must be used and applied.

This new version of NSCV Part B improves consistency across the NSCV and supports our efforts to streamline regulations by introducing two new operational areas categories: 'Extended B' and 'Restricted C'.

To obtain your copy, visit www.amsa.gov.au/domestic/standards/national-standards, and click on B—General requirements.

e-Learning Package for Marine Surveyors Coming Soon

We are about to launch an e-Learning module on the Domestic Training and Education section of the website which helps those preparing to become an AMSA-accredited marine surveyor.

The e-Learning module consists of a series of multiple-choice questions relating to specific categories of accreditation.

New Resources Available on the AMSA Website

- The following updates are now available:
- DCV-A-012 –– Certificate of Competency Grandfathering Arrangements.
- GES 2015/09 (AMSA588) — Use of Life Cell products on Domestic Commercial Vessels.
- GES 2015/12 (AMSA666) — Operational Wave Height for High Speed Craft.

Australian Maritime Safety Authority, *Survey Matters,* October 2015

FROM THE CROWS NEST

Launch of Book by Em/Prof. Lawrence Doctors

Em/Prof. Lawry Doctors made the official presentation of his new book, *Hydrodynamics of High-Performance Marine Vessels*, on 27 August 2015, in Washington DC, USA. The presentation was made to the Society of Naval Architects and Marine Engineers (SNAME) Panel SD-5, Advanced Ships and Craft, together with the International Hydrofoil Society (IHS).

This combined group meets regularly in the greater Washington area. The organisation provides an opportunity for members to hear about the latest developments in the area of high-speed marine transportation. All types of such vessels are of interest to the group. The audience principally comprised attendees from local universities, government and non-government research organisations, as well as representatives of the US Office of Naval Research.

The extended talk consisted of 86 slides, but was restricted to the broad topic of accurate resistance predictions for marine vessels. Due to constraints of time, the other topics of wave generation, sinkage and trim, unsteady effects and motions in waves were omitted. Interested readers of *The Australian Naval Architect* may receive a copy of the presentation by email from l.doctors@unsw.edu.au

FAST 2015 Conference

Since their inception in Trondheim, Norway, in 1991, the biennial FAST conferences have been the world's leading technical conferences addressing fast-sea transportation issues.

The Thirteenth International Conference on Fast Sea Transportation (FAST 2015) was held in Washington DC, USA, the nation's capital. The aim of the conference was to promote world-wide cooperation among scientists, engineers and operators who are concerned with all aspects of the high-speed maritime industry. The FAST Conference program for 2015 focused on high-quality papers. A review of abstracts was used to select papers whose originality, relevance, timeliness, and significance met the standards FAST attendees have come to expect.

A total of 62 papers was presented. The Australian-based presentations were:

1. Mr Nicholas Parkyn presented a paper on *The Design of the* Dynabout*—the Dynaplane Concept Applied to the Design of a More Efficient Outboard Powered Recreational Runabout*". This is a planing boat whose design wetted surface has a downward camber which greatly enhances its hydrodynamic efficiency.
2. Em/Prof. Lawrence Doctors discussed his research on the topic *A Theoretical Study of the Optimal Dynaplane Vessel*, in which the influence of aspect ratio and loading were investigated with respect to improving the planing efficiency.
3. Mr Max Haase, Mr Gary Davidson, Mr Stuart Friezer, A/Prof. Jonathan Binns, Prof. Giles Thomas and Prof. Neil Bose talked about *Full-Scale Simulation-Based Hull Form Design for Large Medium-Speed Catamarans with High Fuel Efficiency*. The aim of their work was the development of large and efficient catamarans.
4. Mr Jason McVicar, Dr Jason Lavroff, Em/Prof. Michael Davis and Prof. Giles Thomas discussed their work on the topic *Slam Excitation Scales for a Large Wave Piercing Catamaran and the Effect on Structural Response*. This has been a multi-year continuing effort by this group of researchers; their new predictions demonstrated realistic slam events.
5. Mr Ahmed Swidan, Prof. Giles Thomas, Prof. Dev Ranmuthugala, A/Prof. Irene Penesis, Dr Walid Amin, Dr Tom Allen and Dr Mark Battley presented their work on the subject *Prediction of Slamming Loads on Catamaran Wetdeck using CFD*. They demonstrated good correlation between CFD predictions and experiments for total slam-force data.

A novel addition to the proceedings this year was a panel discussion on the subject *How Can Fast Ships Fit into a Green World?* Participants in this panel discussion were Em/Prof. Lawrence Doctors (UNSW Australia), Dr Colen Kennell (Naval Surface Warfare Center), Mr Rich Delpizzo (American Bureau of Shipping), Mr David Martin (Air Line Pilots Association), Mr Peter Noble (Noble Associates), and Ms Kelly Cooper (US Office of Naval Research, Chairperson).

The means to achieve environmentally-friendly ships included a discussion of replacing marine diesel fuel with liquid hydrogen. An important advantage of liquid hydrogen is its energy density, which is much higher than that of diesel fuel; this permits a considerable saving in overall vessel displacement for the same cargo-carrying capacity. Gains in effective transport efficiency could also be achieved by the use of alternative and lighter structures made of aluminium or titanium rather than steel. In this case, an apparently lighter and more-efficient structure might not be adopted because of its higher construction cost. The use of biofuels is another approach to reducing pollution. Finally, the evolution of new vessels with a lower specific resistance was proposed. This requires a reduction of the wetted surface and the minimisation of wave resistance, as in the case of surface-effect ships, for example.

The Fourteenth International Conference on Fast Sea Transportation (FAST 2017) is planned to take place in Nantes, France, during June 2017.

Lawrence Doctors

Guide for Sea Trials

SNAME has recently published Technical and Research (T&R) Bulletin 3-47 *Guide for Sea Trials (Progressive Speed, Maneuvering and Endurance)*. This T&R Bulletin release is an update from the 1989 version and was developed under the guidance of the Ships Machinery Committee of the Society with assistance from the Ship Production Committee.

The *Guide for Sea Trials* continues to be an extremely popular bulletin whose purpose is to provide ship owners, designers, operators and builders with definitive information

on ship trials to form a basis for contractual agreement and guidance on the presentation of trial results.

The *Guide* covers sea trials of self-propelled surface ships, commercial or naval, displacing 300 t or more, powered by hydrocarbon fuels such as petroleum, natural gas, and bio fuels and driven by diesel or Otto-cycle engines, gas turbines, or electric motors. It does not cover dock trials, tests or demonstrations which can be conducted dockside.

Last updated in 1989, the current update was needed to keep up with technology and process developments. The earlier versions of the *Guide* were developed by SNAME Panel M-19 (Ship Trials) with assistance from Panel H-10 (Ship Controllability).

Funding and technical support for this update was provided by the National Shipbuilding Research Program (NSRP) to assist with ensuring inclusion of technical expertise from those who perform trials on a regular basis. Those contributing to the update included a variety of volunteers from organisations including shipbuilders, ship owners, ship designers, operators, classification societies, government organisations and others.

The new publication is a 95-page report issued electronically and may be ordered for USD 40 (USD 20 for SNAME members) through the SNAME website (www.sname.org) or by contacting Kristin Walker at kwalker@sname.org.

Pacific 2015 IMC

The Pacific 2015 International Maritime Conference was held at the Sydney Exhibition Centre's temporary premises at Glebe Island on Tuesday 6 to Thursday 8 October. Free ferry services were provided from Darling harbour and Circular Quay, and so many delegates took the scenic route on the harbour.

Following the opening ceremony, a total of three keynote speeches, sixty-five papers in two parallel streams and a shipbuilding quadrilateral were presented. Of the sixty-five papers, forty-five were presented by authors representing Australian companies/organisations/departments.

The Cocktail Reception for the International Maritime Conference was held in the Sydney Room on Johnson's Bay Wharf, Glebe Island, on the evening of Wednesday 7 October. Speechifying was limited to the welcome by the Chair of the Pacific 2015 Organising Committee, John Jeremy, and the presentation of the Walter Atkinson Award for 2015 (see p. 51).

RINA Stand at Pacific 2015 Exhibition

RINA had a stand at the Pacific 2015 Exhibition held at the Sydney Exhibition Centre's temporary premises at Glebe Island on Tuesday 6 to Thursday 8 October.

The stand was crewed almost continuously throughout the Exhibition by the Chief Executive, Trevor Blakeley, together with Australian members of RINA attending the International Maritime Conference and who volunteered their time. Thanks to Aminur Rashid, Jonathan Binns, Rob Gehling, Phil Helmore, Hugh Torresan, Michelle Grech and Alan Taylor.

The RINA stand at Pacific 2015 with (L to R) Trevor Blakeley, Alan Taylor, Stuart Cannon and John Jeremy (Photo Phil Helmore)

Dr Patricia Gruber, Technical Director, US Office of Naval Research Global, giving her keynote address at the Pacific 2015 IMC (Photo John Jeremy)

The Austal stand at Pacific 2015 (photo John Jeremy)

Change of Name from DMO to CASG

The Defence Materiel Organisation has had a formal name change to the Capability, Acquisition and Sustainment Group, or CASG for short, within the Department of Defence. CASG exists to meet the Australian Defence Force's military equipment and supply requirements as identified by Defence and approved by Government.

The *Defence Capability Plan 2012 — Public Version* provides an account of major capital equipment proposals which are currently planned for Government consideration (either first or second pass approval). The projects outlined in this public version of the plan reflect the strategic and Defence requirements outlined in the *Defence White Paper 2009, Defending Australia in the Asia Pacific Century: Force 2030*.

CASG is organised into four business groups which are each headed by a General Manager:

Commercial

Commercial monitors CASG's internal benchmarks, facilitates disposals and export-related activities, including government-to-government sales, in support of the Australian defence industry. It also manages distribution of tenders as well as grants and industry up-skilling programs.

Joint, Systems and Air

Joint, Systems and Air is responsible for all acquisition and sustainment business conducted through CASG's Aerospace; Electronic; Helicopters, Tactical Unmanned Aerial Systems and Guided Weapons; Joint Strike Fighter Divisions and the Standardisation Office.

Land and Maritime

Land and Maritime is responsible for all acquisition and sustainment business conducted through CASG's Land Systems Division, Maritime Systems Division and Air Warfare Destroyer Program.

Land Systems Division: Land Systems Division is a core element of the Capability Acquisition and Sustainment Group acquiring and supporting designated land systems for the Australian Defence Force (ADF).

Maritime Systems Division: Maritime Systems Division provides through-life support services to Navy and Army maritime capability for Australian ships. It supports capabilities like state-of-the-art missiles and torpedos and supplies fuels and prescribed common items to the Australian Defence Force (ADF).

Air Warfare Destroyer Program: The Air Warfare Destroyer program is one of the largest Defence projects ever undertaken. It is a multi-phased project to acquire a multi-role surface combatant which will significantly increase Australia's defence capabilities.

Submarines

The Submarines Group is responsible for all materiel-related aspects of submarine support across Defence, and works closely with the Chief of Navy, other Government departments and industry to get the job done.

For further information, visit www.defence.gov.au/casg.

Phil Helmore

Change of Name from DSTO to DST Group

The Defence Science and Technology Organisation has had a formal name change to the Defence Science and Technology Group, or DST Group for short.

There is no substantive change in the team or the organisational structure. DST Group was always a group within Defence, but now the word has been made explicit in the title. The Chief Defence Scientist continues to report to the Secretary of the Department of Defence.

The Defence Science and Technology Group is the Australian Government's lead agency charged with applying science and technology to protect and defend Australia and its national interests. It delivers expert, impartial advice and innovative solutions for Defence and other elements of national security.

For further information, visit www.australia.gov.au/directories/australia/dstg.

Jimmy Hafesjee
Director Defence Science Communications
DST Group
Department of Defence

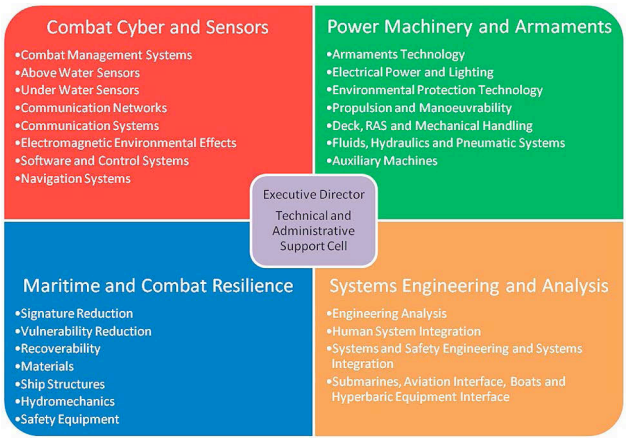
The Naval Technical Bureau—Building Naval Engineering Capability and Capacity

Mr Paul Rizzo in his 2011 report on a review into Navy's early decommissioning of a ship, and the extended non-availability of other ships, identified the need to have an

assured ability to deliver specialist technical products and services across the naval asset lifecycle, from needs definition to eventual disposal. A significant theme in the Rizzo report was the effect of the hollowing out of enterprise-wide Naval engineering capability on the materiel element of naval capability. The development of the Naval Technical Bureau is one of the responses to the recommendation from that Review to rebuild naval engineering capability.

The value of the Naval Technical Bureau, an in-house provider of technical products and services, is the contribution of those products and services to the naval Capability Manager, directly and indirectly, of the delivery of seaworthy materiel. The delivery of these technical products and service is effected through specialist Technology Cells comprising Australian Public Service (APS), Australian Defence Force (ADF), and industry members who are recognised experts in naval engineering.

The Technology Cell construct enables the Naval Technical Bureau to be flexible, adapting to changes in technology, processes, and practices which will provide the technological edge for "fighting and winning at sea"; it must be capable of sensing these changes, identifying how they can provide the technological edge, and incorporate change in response.



The Naval Technical Bureau
(Image courtesy Naval Technical Bureau)

The Technology Cells listed in the diagram deliver specified products and services. They are grouped into domains to promote cross-cell interaction, effective utilisation of assets and targeted broadening of skills and knowledge across cells. The domains enable suitably competent staff to be directed to surge the delivery of specific products, provide pathways for personnel development and build technical mastery.

The cells delivering electronic systems, products and services employed in the naval environment are grouped in the Combat Cyber and Sensors (CCS) domain. This includes networked naval systems which support combat management, electronic warfare and asset networking, communications systems, and hardening of electronic networks and control and sensor systems.

The Power Machinery and Armaments (PMA) domain delivers products and services related to the machines employed in the naval environment. Power generation, distribution and lighting, all types of primary and auxiliary machinery including guns, launchers and other weapons, explosive ordnance in the maritime environment, all fluid systems (except fire safety systems) and environmental control systems are included in this domain.

The cells which deliver products and services which build vessel resilience in the maritime and naval combat environment provide products and services relating to structural integrity, stability and buoyancy, manoeuvrability and seakeeping, reduced susceptibility and vulnerability, hardening and protection, use of appropriate materials, recoverability, evacuation and life-saving; these are grouped in the Maritime and Combat Resilience (MCR) domain.

The fourth domain, Systems Engineering and Analysis (SEA), groups cells delivering whole-of-ship life-cycle engineering products and services. These include RAM, human systems integration including habitability, system interfacing including submarine, aviation, hyperbaric equipment and boats, systems safety, and systems integration.

A shared service element provides services to the Technology Cells which enable the specialist engineers, practitioners and technologists to deliver the products and services.

The Domain Leads form the Naval Technical Bureau leadership team. Strategic leadership and management is provided by Head Navy Engineering, Director General of Engineering—Navy and the Executive Director Naval Technical Bureau.

Development of the foundations and framework for the Naval Technical Bureau was led by the inaugural Executive Director, John Colquhoun, through to his retirement in July 2015. In August, Bruce McNeice was promoted to Executive Director and continues to lead the construction of the Bureau. Around half of the envisaged Technology Cells have been established, with the intention being to have all the core Technology Cells functional with the initial complement of APS and ADF staff by the end of the first quarter 2016. A subsequent period of consolidation is intended to develop strategic industry partnering and shape the Naval Technical Bureau to meet the demands of naval capability sustainment and the future naval shipbuilding program.

Bruce McNeice
Executive Director
Naval Technical Bureau

THE AUSTRALIAN NAVAL ARCHITECT

Contributions from RINA members for *The Australian Naval Architect* are most welcome

Material can be sent by email or hard copy. Contributions sent by email can be in any common word-processor format, but please use a minimum of formatting — it all has to be removed or simplified before layout.

Photographs and figures should be sent as separate files (not embedded) with a minimum resolution of 200 dpi. A resolution of 300 dpi is preferred.

Extending the Range of a Conventional Submarine by Autonomous Covert Refuelling when on Patrol

Martin Renilson

Conventional submarines are much cheaper to own, and to operate, than nuclear-powered ones. Also, they can be much smaller, making it easier to deploy them in shallow water such as in the littoral. However, conventional submarines suffer from lack of range, which restricts their applications, particularly for countries, such as Australia, having the need to patrol large areas. A solution to this dilemma is to build large conventional submarines, such that they can carry sufficient fuel which, in conjunction with snorkels and/or air-independent propulsion (AIP), can be used to extend their range. Larger submarines are more expensive, both in acquisition and operating costs, and have greater signatures than smaller ones. Thus, there would be a considerable advantage if it were possible to extend the range of a small to medium sized conventional submarine by a covert refuelling technique.

Although such an idea may be somewhat fanciful, it is similar to that relied upon today in a routine manner for operating modern fighter jets, which are not capable of carrying sufficient fuel to carry out their routine missions. It is also commonly used for surface warships. The purpose of this paper is to discuss a possible solution to the problem of refuelling submarines. Whilst it is accepted that the concept is far from reality at this stage, the potential advantages, if it could be achieved, certainly make it worthy of further consideration.

CONCEPT

The concept is to provide the ability to conduct covert underwater refuelling of conventional submarines when on patrol.

This is based on the use of submerged fuel tanks, which can be statically located at strategic positions in the patrol area. For routine operations the fuel tanks would be transported to the patrol area in advance by surface ships, and then moored to a float in the desired location. It will also be possible to drop fuel tanks by air, which would allow for changes in the patrol area to be made at short notice when a suitable surface ship is not available.

The fuel tanks would be fitted with a dropper which would have a connection fitting in a similar manner to that proposed in Reference 1. The submarine will then approach the fuel tank and will make use of a taught wire with a bespoke connection fitting using a specially-designed low aspect ratio wing to "capture" the fuel tank as described in Reference 1. Once captured, the fuel tank would be winched to the submarine, where it would be secured, permitting transfer of fuel.

REFUELING EQUIPMENT

The equipment required for the covert refuelling procedure comprises a fuel tank with an internal bladder tank, a refuelling arm, a dropper/connection line, a float and mooring line, a warp, catching device and controllable low aspect ratio wing deployed from the submarine and a fuel line connector on the submarine.

Fuel Tank

A sketch drawing of the fuel tank is shown in Figure 1. This would have dimensions of up to approximately 20 m × 2 m (beam) × 2.5 m (draught) and have a displacement of around 50–60 t. This is similar to the dimensions of existing Swimmer Delivery Vehicles which can be deployed from aircraft. Smaller fuel tanks could be used, particularly in conjunction with smaller submarines.

The fuel tank would be fitted with fixed stabiliser fins, and ballasted with slight positive buoyancy, and such that it will sit "upright" underwater when not connected to the mooring arrangement. It would be fitted with a bladder-type fuel tank, with a capacity of the order of 40 000 L, and free-flood vents to permit sea water to enter as the bladder tank is emptied.

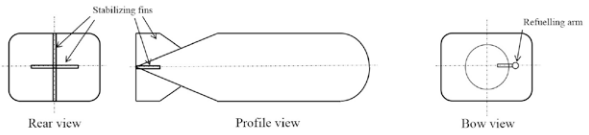


Figure 1: Fuel tank (NTS)

A refuelling arm would be fitted on the starboard side of the fuel tank, close to its forward end, as shown in the bow view in Figure 1. This would be used to transfer fuel to the submarine, once the fuel tank has been docked with it, as discussed below.

Mooring Equipment

A dropper/connection line would be attached to the nose of the fuel tank, and a float and mooring line attached to its stern. Prior to being coupled with the submarine it will float in the water as shown in Figure 2.

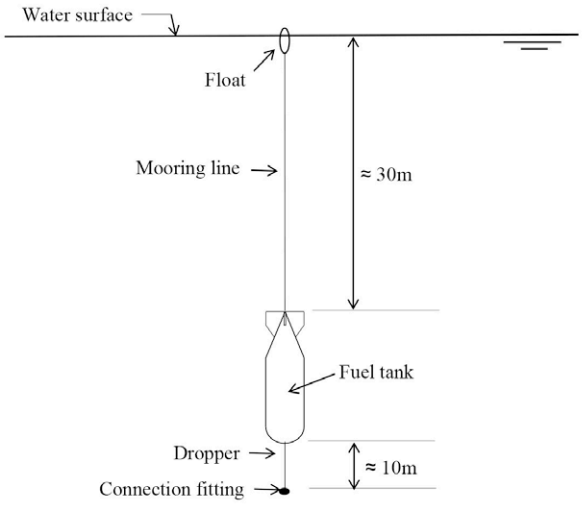


Figure 2: Equipment deployed and awaiting submarine (NTS)

With the arrangement shown in Figure 2 the fuel tank would be suspended sufficiently far below the water surface such that motions imparted to it by ocean waves would be negligible. As noted above, the fuel tank would be slightly positively buoyant. The connection fitting will be similar to that described in Reference 1 for recovering UUVs. It would include sufficient mass to balance the system, such

that it is in stable equilibrium, as shown in Figure 2.

Catching Equipment

The submarine would be fitted with a warp and catching device, similar to that described in Reference 1. The warp would be deployed from the starboard side of the rear of the sail.

As the submarine approaches the fuel tank system shown in Figure 2, it would deploy the warp as shown in Figure 3. The warp would be drawn outboard from the starboard side of the sail by a low aspect ratio wing. This will be stable at a high angle of attack, in a similar manner to an otter board being deployed by a trawler, as discussed in Reference 1.

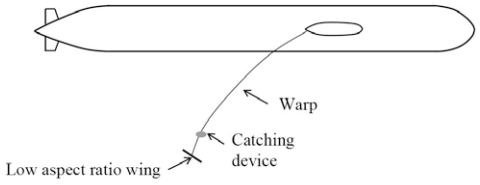


Figure 3: Plan view of catching equipment deployed from submarine (NTS)

The transverse position of the catching mechanism can be controlled by varying the length of the warp deployed, using a winch from within the sail. The vertical position of the catching mechanism can be controlled by using a small trim tab on the wing, operated by remote control from the submarine using a signal transmitted through a cable within the warp. This means that the location of the wing can be controlled in both the horizontal and vertical planes from within the submarine, as shown in Figure 4.

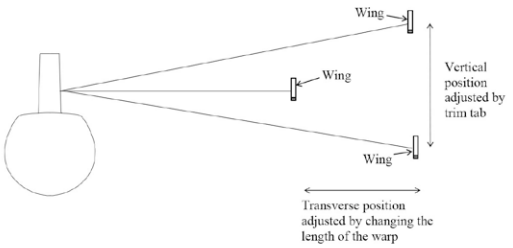


Figure 4: End view of submarine with catching equipment deployed (NTS)

Submarine Fuel Line Connector

The submarine would be fitted with a retractable fuel line connector on the port side of the sail. This would incorporate a "basket" similar to the one used for air-to-air refuelling when using the "probe-and-drogue" system, as shown in Figure 5. It would be designed to dock the refuelling arm from the fuel tank.

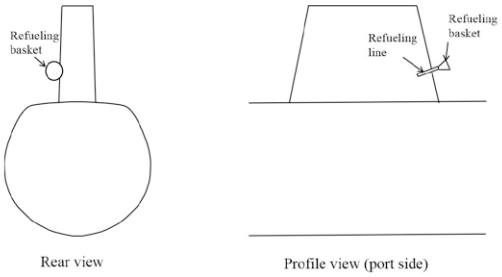


Figure 5: Refuelling line (NTS)

REFUELING PROCEDURE

First the fuel tank would be deployed to a suitable site. It could be dropped from an aircraft, or launched from a surface ship.

Once in position, the fuel tank will deploy its float, mooring line, dropper, and connection fitting with incorporated mass, as shown in Figure 2. It will be stable in this position, and, although it may drift slightly, in principle it could remain in this configuration for an extended time.

The submarine would then deploy its catching equipment, as shown in Figures 3 and 4. It would approach the moored fuel tank arrangement at a depth of around 50–60 m, at a speed of 4–6 kn. At this depth motions imposed by the surface waves would be minimal, and the submarine would be able to be controlled easily (Reference 2).

The position of the warp would be fine-tuned as shown in Figure 4, such that the warp encounters the dropper inboard of the catching device, as shown in Figure 6.

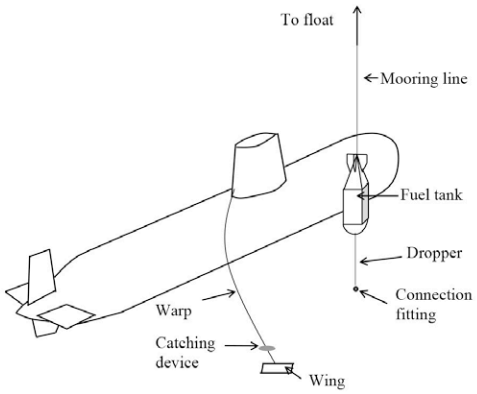


Figure 6: Schematic of submarine approaching fuel tank and equipment (NTS)

The dropper would slide up the warp until the connection fitting meets the warp. At this point, the connection fitting would clip around the warp. The connection fitting would then slide along the warp to the catching device. Once the connection fitting enters the catching device, the catching device would close and a positive linkage will be made between the dropper and the warp. This process is similar to the mooring line of a mine being picked up by the sweep wire in a specialised mine-hunting rig. It has the advantage that the exact diameter of the dropper is known, and there is a bespoke connection device at the end of the dropper.

As the submarine continues, it will start to tow the fuel tank using the dropper (which will now become a towing line), and the float will be reeled automatically into the rear of the fuel tank, as shown in Figure 7.

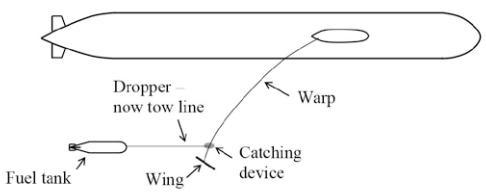


Figure 7: Plan view of submarine towing fuel tank (NTS)

The warp can then be winched towards the submarine, with the fuel tank firmly attached. The fuel tank will then settle into a position directly behind the sail, and its refuelling arm would insert itself into the basket of the refuelling line on the submarine, as shown in Figure 8.

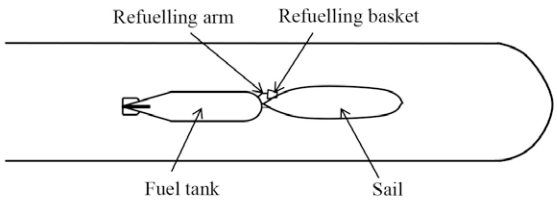


Figure 8: Plan view of submarine with fuel tank docked behind the sail (NTS)

At this point the refuelling can begin. As the fuel is stored in a bladder within the fuel tank, it will be under pressure, and so when the valve in the refuelling arm is opened the fuel would flow into the submarine under its own pressure. However, a pump on the submarine would be required to completely empty the bladder.

As the fuel is being emptied from the bladder on the fuel tank, it will be being replaced by sea water through free-flooding vent holes. Thus, the fuel tank will take on slightly more mass during this process; however, its design would ensure that it remains slightly buoyant.

As it takes on fuel, the submarine will become heavier, however this would be able to be controlled as it will have sufficient forward motion, and will be able to pump out compensating ballast as required (Reference 2).

Once the refuelling has been completed the fuel tank can be jettisoned, and its float redeployed. This would take it back to the surface, where it will float in equilibrium as in Figure 2, until it is collected by a surface ship. In times of hostility, when it cannot be collected, a vent in the float can be triggered to open, and the whole system would sink to the bottom.

DISCUSSION

As noted in the introduction the process described above is far from reality at present. There are many engineering difficulties to be overcome. However, none of these are likely to become "show stoppers", provided that sufficient effort is made to address them in the long term. The advantages to the operation of conventional submarines certainly make the concept attractive, and so it is worth devoting considerable effort to overcome any of the engineering issues.

When the submarine is undergoing the refuelling procedure it will be vulnerable, but much less so than if it were doing this when on the surface. Also, less so than a surface ship undergoing replenishment at sea, or a fighter aircraft being refuelled from an airborne tanker.

The need to locate the fuel tank in its position in advance may limit the flexibility of the submarine's mission. However, as noted above, the fuel tank could be dropped by air in such circumstances. Either way, it is conceivable that an enemy may be aware that a submarine could be operating in the general region.

It may be possible for the fuel tank to be arranged such that it can sit on the seabed and only deploy its float and mooring system on command from an approaching submarine.

A means of allowing the submarine to detect the fuel tank would be required, and this may also give its location away to the enemy. This issue will need to be addressed, potentially in a similar manner to the way in which the location of a UUV returning to the submarine is dealt with.

Although the concept described above is intended for refuelling diesel submarines, it may be possible to adapt this for liquid oxygen, such that it could be used for refuelling submarines which use AIP.

Finally, as most of the equipment required on the submarine is based outside the pressure hull in the sail, with only a refuelling line penetrating the pressure hull and going to the fuel tanks, it may be possible to retrofit this concept to existing submarines, to extend their range. It would certainly be possible to add this concept at a late stage in the design for a new submarine.

It is therefore strongly recommended that this concept be considered further, and that the various issues be investigated in detail, possibly making use of a technology demonstrator.

CONCLUDING REMARKS

Conventional submarines are much cheaper to own and to operate than nuclear-powered ones, however they suffer from lack of range, which restricts their use in many applications.

A novel concept for covertly refuelling conventional submarines whilst they are on patrol has been presented. This would permit the extension of their range and endurance, without significantly compromising the stealthy nature of their operations.

The concept is far from reality at present. There are many engineering difficulties to be overcome. However, none of these are likely to become "show stoppers", provided that sufficient effort is made to address them in the long term.

The advantages to the operation of conventional submarines certainly make the concept attractive, and so it is worth devoting considerable effort to address the engineering difficulties. It is therefore strongly recommended that this concept be considered further, and that the various engineering difficulties be investigated in detail, possibly making use of a technology demonstrator.

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Martin Renilson is Dean, Maritime Programs, Higher Colleges of Technology, UAE and Adjunct Professor, University of Tasmania. This paper was accepted for the Pacific 2015 International Maritime Conference but Prof. Renilson was unable to present the paper.

EDUCATION NEWS

Australian Maritime College

PhD Partnership at AMC welds Research with Industry Experience

AMC PhD candidate Curtis Armstrong has partnered with deep-water engineering specialists INTECSEA on a research project to help protect and get better performance from their riser flow-line systems.

Riser flow lines act as the arteries for the oil and gas sector, transporting oil, gas and other chemicals through a hose-like system on subsea installations. Their effective and safe design is paramount to the success of a venture.

Curtis Armstrong will simulate the floating facility, its riser system and the environmental conditions in which it operates using response-based analysis (RBA) modeling. The three-year project is jointly funded by the Australian Maritime College at the University of Tasmania and INTECSEA, part of the Advisian consulting business of Worley Parsons.

RBA modelling has already been proven on ship-shaped floating vessels, but this project will be the first to apply it to riser systems.

"Risers are difficult to analyse because they are mostly flexible, hose-like structures of complex construction with spans reaching from sea-surface to seabed. A lot can happen when this system is exposed to such a complex force of nature as the ocean. Another factor is that the riser system is joined with a floating vessel and its mooring anchors with their own dynamic responses," Mr Armstrong said.

"My research aims to develop RBA for riser flow lines when they are coupled with the other systems and help protect the arteries of the offshore oil and gas industry by preventing loss of assets through failure, reducing costs through efficient design methodology, and conserving the environment in which they operate."

Until recently, companies have relied on data collected from ocean buoys measuring wave height and wind speed to determine the extreme conditions which will act on their multi-million dollar equipment. This modeling approach is flawed, as it predicts only 'perfect storm' scenarios, or the biggest possible wave which could hit the system.

It's not necessarily one big hit which will break a structure, rather the many smaller ones which will resonate with its natural frequency and cause it to fail. RBA modeling will provide a much clearer picture of what happens when the system is exposed to every single data packet of the buoy that has been floating in the ocean for decades, not just the big hits.

Curtis Armstrong at the AMC towing tank
(Photo courtesy AMC)

Perth-based offshore engineering consultancy INTECSEA will provide in-house supervision and part-time employment for four months each year during Curtis Armstrong's PhD tenure.

"This partnership is unique to my project and will provide a great experience, meshing research and industry experience with a common objective," he said.

The project was proposed by INTECSEA and the research and tools developed will be used by the company for its front-end engineering services. The results will be applied to riser design and integration of the risers with mooring systems and floating structures. They will also be incorporated into the teaching of AMC's undergraduate offshore engineering program.

Naval Shipbuilding Courses at AMC

It was announced on 26 October that AMC Search and Babcock International Group have signed an agreement to jointly deliver specialist short courses in maritime studies, including naval shipbuilding, ship design and complex naval systems.

The aim is to help develop the next generation of defence and industry maritime project personnel, naval architects and designers to support the Australian and New Zealand shipbuilding and sustainment programs.

AMC Search CEO, Dean Cook, said that the alliance provided an exciting opportunity to deliver Australia's largest range of maritime short courses into new markets.

"AMCS, in collaboration with Babcock Training Academy, is looking forward to working with industry to develop new products to meet their training needs," Mr Cook said.

Babcock Australia and New Zealand CEO, Craig Lockhart, said that the academy's core goal was to meet the naval sector's future skills requirements and teaming with AMCS would ensure that quality content was delivered across Australia.

"Our agreement with AMCS presents students and industry with a compelling pathway into an exciting career in the maritime sector. The timing for these short courses could not be more advantageous for students, as the industry is now the focus of enormous investment in Australia and overseas as governments seek to create a continuous naval shipbuilding capability," Mr Lockhart said.

AMC Search is the commercial arm of the Australian Maritime College and a wholly-owned subsidiary of the University of Tasmania. It is one of Defence's key divisional suppliers and is responsible for tailoring training to meet industry needs. The company delivers between five and twelve short courses per week, varying in length from one-day refresher courses through to longer 20-day block training sessions.

Recently launched in Australia, Babcock Training Academy already delivers courses in Canberra, Brisbane and Adelaide to students across areas including naval weapons systems,

electronic warfare and engineering aspects of global positioning systems, and will ramp up its activities to deliver between 20 and 30 courses by the end of 2015.

Crew puts Simulated Icebreaker Through its Paces at AMC

A simulator which trains icebreaker crews to safely navigate polar waters is one step closer to reality, following validation of the virtual model of *Aurora Australis* at the Australian Maritime College.

In October, *Aurora Australis* Captain Murray Doyle and Third Officer Katrina Beams put the virtual icebreaker through its paces over three days of testing, providing feedback on the accuracy of ship-ice interaction.

"It's pretty close to the ship's operational parameters — when you're steering and using the simulator's thrusters you get the same feeling as if you were operating *Aurora Australis*," Captain Doyle said.

This final phase of testing marked the end of the project's practical component for researcher Paul Brown, who spent seven weeks aboard the real icebreaker collecting data on how she behaved in a range of conditions.

"During that voyage, I collected more than 40 days of data, photos and videos on the ship's performance in conditions ranging from open waters to heavy seas, icebreaking and snowstorms. All of this information was used to develop the simulated Antarctic environment and icebreaking part of the ship model," he said.

"The aim was to create a virtual training tool that was as close to the real-world environment as possible, and there is no better person to validate our simulated model than the captain of *Aurora* himself."

The three-year project was developed to meet the future training needs of companies such as P&O Maritime, who must comply with a new international code of safety for ships operating in polar waters which is expected to be introduced in January 2017. It will be a mandatory requirement for all chief mates, masters and navigation officers to hold formal ice navigation qualifications.

Captain Doyle said that there were a range of benefits to completing an ice navigation course in a simulator prior to encountering the real thing.

"Airline pilots are put in simulators well before they're allowed to go near a cockpit of an aircraft, so using a simulator gives you a lot more confidence and training to actually do these things. It lays a basic foundation for what you will need to learn later on," he said.

"The simulator will be an important tool for the training of new and existing officers — it will give them a better understanding of the interaction of ship operations in ice, leading to greater safety and efficiency and reducing wear and tear on the vessel."

P&O Maritime has worked closely with Paul Brown on the project with the intention of using the virtual model of *Aurora Australis* to train its icepilots.

Paul Brown is now consulting with commercial arm, AMC Search, to develop and approve two new ice navigation courses using the simulated training tools. The aim is to have the products online next year in preparation for the 2016–17 Antarctic season.

"The real satisfaction will come when I see experienced ice navigators, such as Captain Murray Doyle and Katrina Beams, leaving here with their internationally-recognised qualifications. That really will be the icing on the cake," he said.

Racing Rats, Dynamic Decks and Serious Design

Budding engineers at the AMC have put classroom theories to the test in two hotly-contested annual events, the Rat Trap Boat Race and Skateboard Design Project.

The hands-on projects are the major assessments for AMC's first-year maritime engineering students and both took place on Friday 2 October.

Aurora Australis Captain Murray Doyle, AMC researcher Paul Brown and *Aurora Australis* Third Officer Katrina Beams in the ship simulator (Photo by Chris Crerar, courtesy AMC)).

The day started with the Rat Trap Boat Race held over a 10 m course in the model test basin. Eighty five students have been working in teams for weeks to design and build fast, intelligent vessels as part of their dynamics unit — the catch is that they must be powered entirely by a rat trap.

Clodagh McKechnie, Christopher Buchanan, Connor Hickey, Brett Johnstone, Xuan Guang Zhu and Hwei Ru Lee
(Photo courtesy AMC)

Connor Hickey's team settled on a catamaran design made from balsa wood.

"We've done a lot of testing of the vessel — we've been trying to configure what gearing systems and paddle sizes will work best in the water," he said.

"The biggest challenge was getting the boat to go 10 m; distance was a huge thing, so we incorporated a gearing system to try and give us an advantage over the rest. It's like the gears on a push bike, it starts off at a higher gear and then moves down to a lower gear so it's able to accelerate throughout the course."

He said that the project had built on his experience with hand tools and woodwork, as well as developing effective teamwork skills.

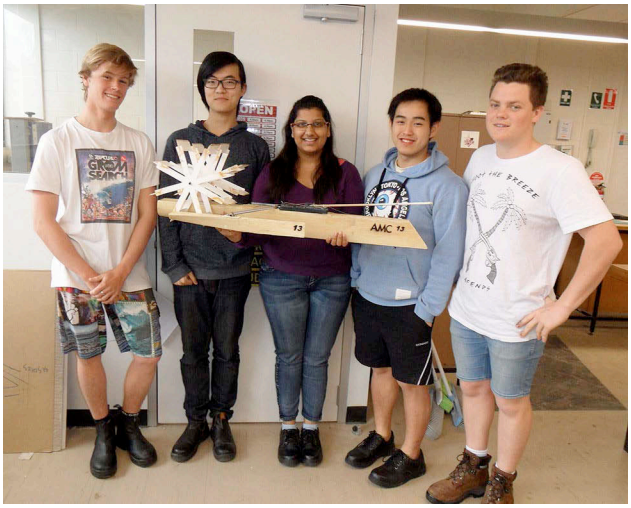
The boat race was followed by street performance testing of the Skateboard Design Project entries built as part of the materials technology unit. The students were tasked with designing a composite deck after researching current best practice.

Their designs, featuring a wooden core sandwiched between fibre-reinforced epoxy-resin cladding, were assessed for their strength and flexural properties before undergoing the final test.

National Centre for Maritime Engineering and Hydrodynamics Deputy Director (Students & Education), Dr Christopher Chin, said that the aim of the projects was to test students' knowledge and develop their project-management skills.

"These hands-on projects provide a platform for students to apply their knowledge and skills to solve practical engineering problems. They are also good team-building exercises and the students must ensure that their work meets strict guidelines," Dr Chin said.

The Rat Trap Boat Race was won by Team 13 – Thomas Kelly, Pragya Gupta, Guixin Fan, Kai Xiang Chong and Michael Connellan, with a time of 24 seconds.



The winning team: Thomas Kelly, Guixin Fan, Pragya Gupta, Kai Xiang Chong and Michael Connellan
(Photo courtesy AMC)

Underwater Robots Rise to Challenge

Designing and building an autonomous underwater vehicle is no small feat, but teams of maritime engineering students at AMC have drawn on their technical and problem-solving skills to do just that as part of the AUV Design Project.

AUVs are untethered robots which are programmed to travel underwater and collect scientific data without directed input from the operator.

Twenty-six students have spent the past semester studying AUV hull design, process control and integrated system design, and have applied this knowledge to build their own underwater robots in teams.

These robots faced the ultimate test when they were put through their paces in AMC's Survival Centre pool. The challenge represents the final assessment in the underwater vehicle technology unit in the third year of their naval architecture degrees.

AMC lecturer Dr Alex Forrest said that the goal was to address challenges in AUV design which are not able to be taught in the classroom.

"The idea is to teach students the challenge of building a system which will be able to operate untethered to complete a goal. To do this, they will bring together knowledge of hydrostatics, hydrodynamics, control theory, programming and sensor integration," Dr Forrest said.

"In addition to being able to conduct operations, they must also address the key scientific goal of measuring water temperatures and reporting back on the associated temperature variability of the water column."

The student brief was to design an AUV capable of diving and maintaining a fixed depth and heading with four operational modules: power, propulsion, control and scientific payload (data-capturing sensors).

Measuring from 1–2 m long, the torpedo-shaped robots may look similar but it's the engineering work which goes into the modules which influences their performance and success.

Dr Forrest said that the project also helped students to develop their teamwork and communication skills, as they must complete an oral presentation and final report in addition to participating in the demonstration.

University of New South Wales

Undergraduate News

Visit to AMC

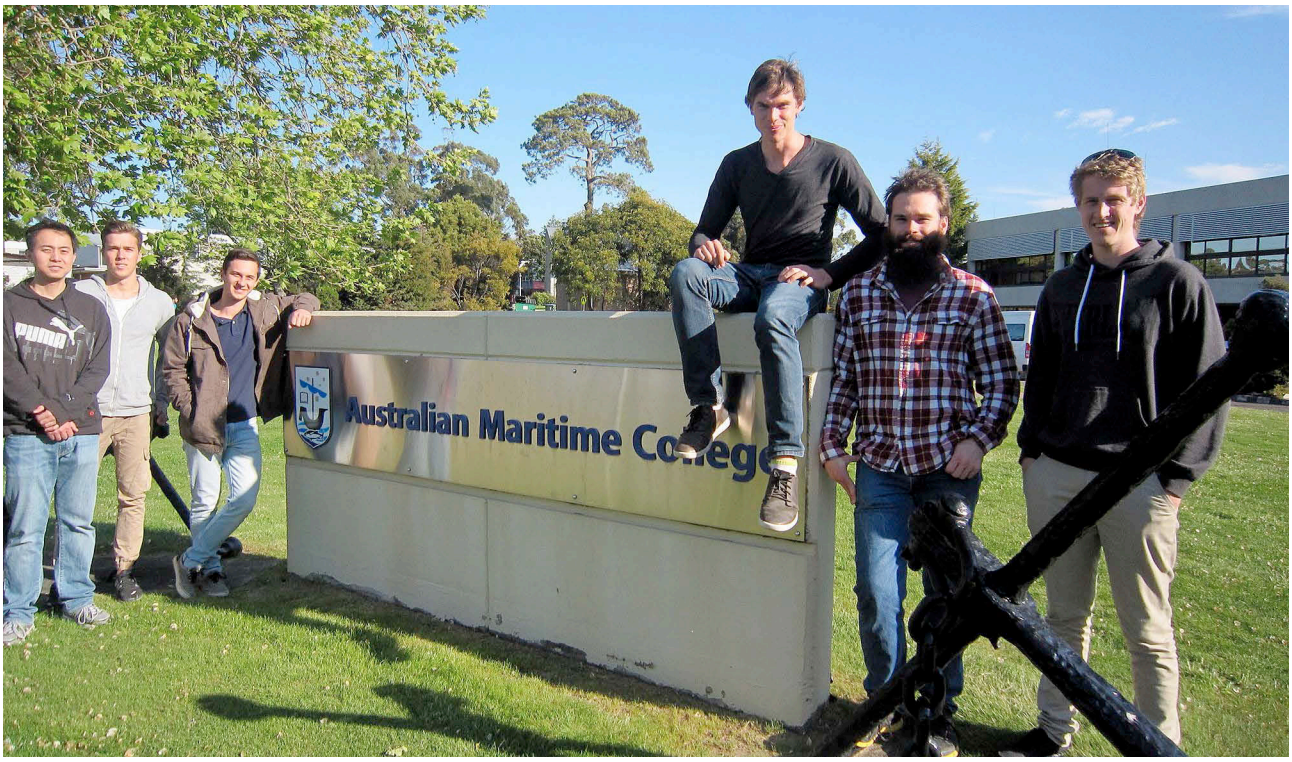
On 15 and 16 October the Year 3 students studying Ship Hydrodynamics visited the Australian Maritime College accompanied by Mr Phil Helmore. The visit was organised by Dr Tim Lilienthal, and UNSW is grateful for AMC's hospitality.

The group first embarked on a program of resistance tests on a 1:20 scale model of the AMC training vessel *Bluefin* in the towing tank, with a range of speeds corresponding to 2–14 kn at full scale. After lunch, Dr Lilienthal showed them over the manoeuvring basin where a PhD student had an experiment in progress. They then conducted a program of seakeeping tests in the towing tank on *Bluefin* at a speed corresponding to 8 kn, firstly in in head seas corresponding to 1 m wave height at frequencies of 0.11–0.27 Hz, and then at a frequency of 0.21 Hz with wave heights of 0.5, 1.0 and 1.5 m (all at full scale). After seakeeping, the group visited Beauty Point where they saw the AMC training vessels *Stephen Brown* and *Reviresco.*

Next day they were given a presentation on cavitation by Dr Bryce Pearce, which they enjoyed, and were then treated to a demonstration of cavitation on a sphere at various pressures and speeds of flow in the new cavitation tunnel. They then listened to an overview of research opportunities by Dr Alex Forrest, and the AUV program in particular. Dr Adam Rolls introduced them to the shiphandling simulator, and showed them the handling characteristics of the 300 m bulk carrier *Pacific Triangle* entering Newcastle Harbour, and compared that with the handling of the cruise vessel *Celebrity Solstice* entering the same harbour. The students were then given command of an Anzac-class frigate to enter Sydney Harbour. It took a little while for Captain Geoff McCarey (on the helm) and Chief Engineer James Johnston (on the throttle) to get used to the handling, but steamed successfully up the westbound channel towards Bradley's Head. An outbound cruise ship appeared, requiring avoiding action, then fog closed in, requiring navigation by the radar. A tanker outbound from Gore Cove came even closer in the westbound channel! Yachts going in several directions added to the melee, but the students managed to put the vessel alongside the Overseas Passenger Terminal at Circular Quay without the assistance of tugs; not bad for a first attempt!

The students all came away with a better understanding of ship model testing, cavitation and shiphandling, and how it is done in practice. It certainly helped to have naval architects talk about the various aspects of testing and research, and their explanations of the processes brought out the realities and practicalities which you don't get in the theory.

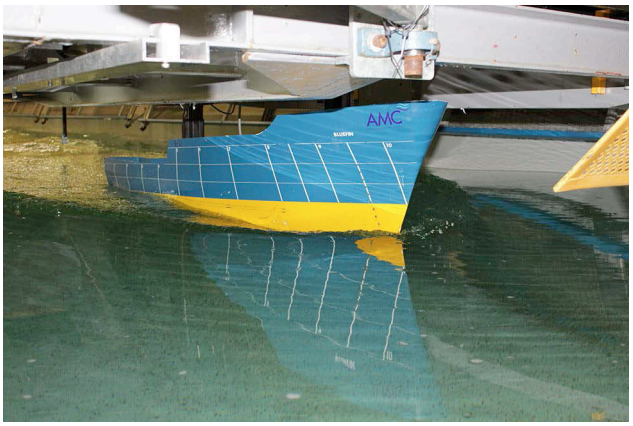
Tim Lilienthal (L) showing Geoff McCarey and James Johnston how to control the carriage and record the resistance tests (Photo Phil Helmore)



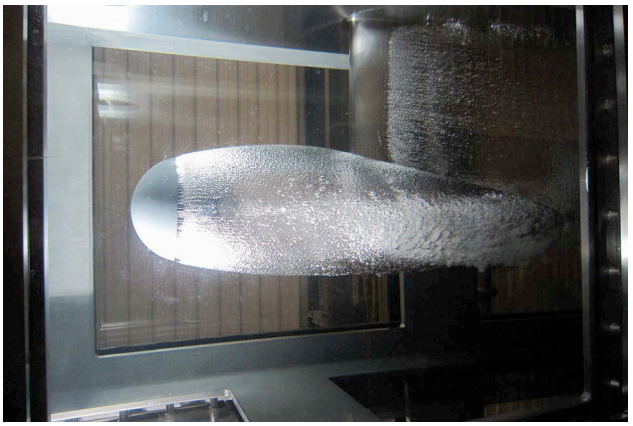
UNSW students at the Australian Maritime College (L to R) Jiong Wang, Peter Knudsen, Geoff McCarey, Angus Bratter, Brett Ryall and James Johnston (Photo Phil Helmore)

Bluefin model at a speed corresponding to 14 kn in the towing tank
(Photo courtesy AMC)

AMC training vessel *Reviresco* at Beauty Point
(Photo Phil Helmore)



Seakeeping tests on *Bluefin* in regular waves
(Photo courtesy AMC)



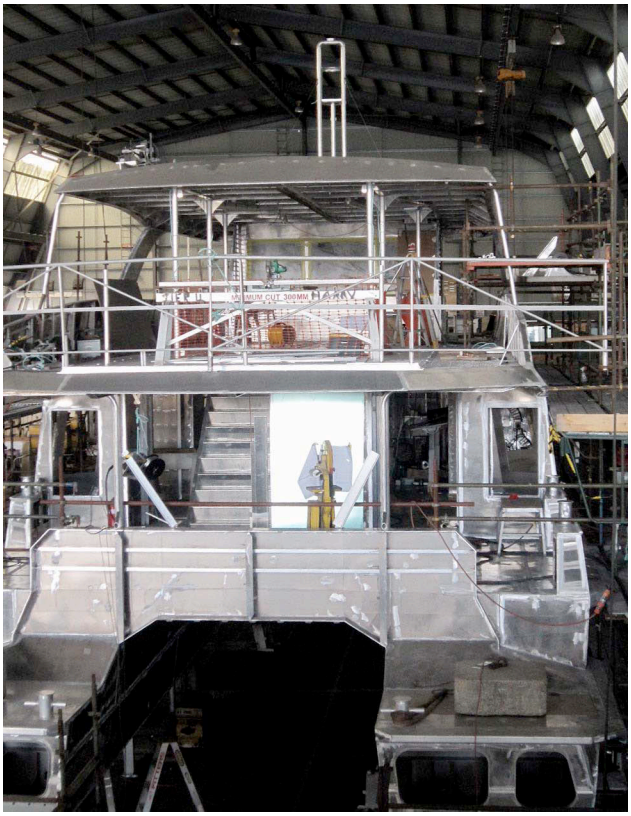
Cavitatation on a sphere
(Photo Phil Helmore)

AMC training vessel *Stephen Brown* at Beauty Point
(Photo Phil Helmore)

Adam Rolls (centre) piloting *Pacific Triangle* into Newcastle
(Photo Phil Helmore)

Visit to Incat Tasmania

The students took the opportunity, while in Tasmania, to visit Hobart, where they were shown over the Incat Tasmania facility at Derwent Park by Revolution Design's Principal Structural Engineer, Gary Davidson. Incat had four vessels at various stages of construction; two 24 m passenger catamarans (with deckhouses on) and two 34 m passenger catamarans (hulls decked), all designed by One2three Naval Architects for Bass and Flinders Cruises in Sydney. It was instructive to be able to see, at first hand, the details of construction. The theory is interesting, but seeing construction under way brings it alive!



24 m passenger catamaran under construction at Incat Tasmania
(Photo Phil Helmore)

Setting the stern bearings in place with Chockfast on a 24 m passenger catamaran
(Photo Phil Helmore)

Gary Davidson discussing details of construction with the students on the deck of a 34 m passenger catamaran
(Photo Phil Helmore)

Following the visit to Incat, the students drove up Mount Wellington to take in the view in windy, freezing-cold conditions, then browsed the Salamanca Markets and walked along the wharves where *L'Astrolabe* (the French icebreaking research vessel), *Seahorse Horizon* (Defence Maritime Services' training vessel), *Bluefin* (AMC's training vessel which the students had tank tested), and *Investigator* (CSIRO's brand-new research vessel) were berthed. They then checked out Battery Point and the finisher's box for the Sydney–Hobart yacht Race.

UNSW students alongside Bluefin in Hobart
(Photo Phil Helmore)

CSIRO's brand-new research vessel *Investigator*
(Photo Phil Helmore)

Thesis Conference

At the School's annual undergraduate thesis conference on 28–30 October the following presentations on naval architecture student projects were made:

Alvin Lim	*Automated Drawing of Ka Series Marine Screw Propellers using AutoCAD*
Nazrin Mohd Fauzi	*Methods of Estimation of the Overall Life-cycle Costs of Tankers*
Molly McManus	*Energy Efficiency and Emissions Prediction Methods for Tugs and Cruise Ships*
Alistair Smith	*Validity, Accuracy and Implementation of Inclining Methods*
Dov Sobel	*Design Methodologies for Newbuilding and Conversion of FPSO Vessels*
Mitchell Stubbs	*CFD Analysis of the Freestyle Swimming Stroke*
Elisa Taniputra	*Investigation of Submerged Hydrofoils: Improving Vessel Efficiency and Performance*
Alexander Walter	*Development and Validation of a Crash-stop Prediction Program*
Bryce Waters	*Investigation and Comparison of VPPs with Recorded Yacht Data*

Thesis Projects

Among the interesting undergraduate thesis projects recently completed are the following:

Automated Drawing of Marine Screw Propellers

One of the more difficult tasks in modern CAD software is creating the drawing of a propeller for manufacture. Previous theses have looked at automating the drawing of MARIN B-Series propellers from the design data using ProEngineer, Catia, AutoCAD and Rhino.

Alvin Lim has extended this work to MARIN Ka Series propellers. This has been challenging because the Ka Series offsets do not allow for an arbitrary edge thickness like the B Series, and one of the hardest parts of the automation process is the insertion of the fillet radius between the blade and the boss. Previous theses have not achieved this very well, but Alvin has been able to achieve it via manual intervention which takes a few minutes longer.

One advantage of the modelling process is that, in addition to the drawing, the mass and polar moment of inertia can be readily calculated within the software.

Energy Efficiency and Emissions Prediction Methods for Tugs and Cruise Ships

Growing attention is being paid to the emissions from ships, i.e. the greenhouse gases (GHG), nitrous oxides (NOx) and sulphurous oxides (SOx). The International maritime Organisation has published the Energy Efficiency Design Index (EEDI) and the Energy Efficiency Operational Index (EEOI) . In addition, the recent publication of a method for calculating the emissions of vessels based on the fuel consumption, route, usage, etc. by the National Technical University of Athens has provided a basis for further study. The vessels analysed in the study were generally large, tankers, bulk carriers, container ships and the like, and these are also the basis for the IMO guidelines on the EEDI and EEOI.

Molly McManus has obtained operational data for two different types of vessels, and has analysed their emissions using the IMO and NTUA guidelines.

Graduation Ceremonies

At the graduation ceremonies on 10 and 13 November, the following graduated with degrees in naval architecture:

Muhammad Syahmi Hashim	Honours Class 2, Division 1
Thomas van Peteghem	Honours Class 2, Division 1
Renjie Zhou	

They are now employed as follows:

Syahmi Hashim	Evaluating opportunities
Thomas van Peteghem	Master of Management Innovations degree, Paris
Renjie Zhou	Evaluating opportunities

Congratulations all!

Renjie Zhou and Phil Helmore at Graduation Ceremony on 10 November
(Photo courtesy Zhou Family)

Post-graduate and Other News

HoS Elected Fellow of ATSE

Head of School of Mechanical and Manufacturing Engineering, Prof. Anne Simmons, has been recognised for her technological innovation by being elected as Fellow of the prestigious Australian Academy of Technological Sciences and Engineering.

The 26 new Fellows elected by their peers for 2015 come from a wide array of disciplines including agriculture, engineering, water management, biotechnology, resources, chemicals, photonics, robotics and medical research.

Prof. Simmons is an outstanding innovator, mentor and role-model for young women in engineering and has helped shape biomedical engineering in Australia. She is one of the leading experts in Australia and prominent internationally in medical-device technology, innovation and commercialisation. Prof. Simmons has had successful careers in both industry and academia. For nearly 20 years with the Nucleus Group, she was involved with the development, commercialisation and distribution of a range of novel medical devices and technologies.

The full list of 2015 Fellows is available on the ATSE website,

https://www.atse.org.au/content/publications/media-releases/2015/women-prominent-among-new-atse-fellows.aspx

Phil Helmore

Prof. Anne Simmons
(Photo courtesy Diane Augee)

The couta boat *Sorrento* (C118) competing in the Couta Boat Regatta conducted by the Royal Prince Edward Yacht Club on Sydney Harbour in sparkling conditions on 16 October. Nineteen boats took part, including six from Victoria and the Australian National Maritime Museum's *Thistle*
(Photo John Jeremy)

BMT Whole-life Warship Capability Management Course

In August BMT Design & Technology (BMT), a subsidiary of BMT Group Ltd, delivered the first Whole-life Warship Capability Management course in Canberra to a full enrolment of defence, government and industry participants. The four-day course presented delegates with the knowledge to plan for and manage the capability definition, acquisition and sustainment phases of warship ownership. The course is the only one of its kind in Australia and has been developed to assist with the challenge of sustaining the existing RAN fleet, whilst preparing for major acquisition programs including offshore patrol vessels, frigates, replenishment ships and submarines.

The course is scheduled to run again on 16 November 2015.

The course provides detailed insight into the processes and management of warship projects as well as the key engineering activities and disciplines that are integral to ship design, with modules including:

- Capability Development;
- Requirements Management;
- Design Process and Safety;
- Technical Evaluation;
- Design Control and Validation;
- Cost Engineering;
- Standards, Certification and Regulation;
- Hydrostatics and Hydrodynamics;
- Power and Propulsion;
- Hull and Mechanical Systems;
- Electrical and Control Systems; and
- Through-life Support.

A number of international experts were invited to present to the course delegates, including Prof. Jonathan Gates, who has held a number of senior positions on major UK naval projects and recently published a book for the Royal Navy on the Type 45 destroyer. He presented topics discussing Battlespaces and Total Ship Survivability which demonstrated the impact sensors, effectors and command-and-control elements have on the acquisition process and whole-of-life support.

Gordon MacDonald, Managing Director of BMT Design & Technology, also presented at the course and said "The BMT Whole-life Warship Capability Management Course shares our expertise in warship design and program management with the naval community, and gave the delegates numerous opportunities for interactive discussion and debate. We are thrilled by the positive reception and active participation which we received from those who attended."

Lockheed Martin Builds New Combat System Lab

Lockheed Martin Australia will open a submarine combat system laboratory in Mawson Lakes, South Australia, in November to support the company's pursuit of the Royal Australian Navy's future submarine project SEA 1000.

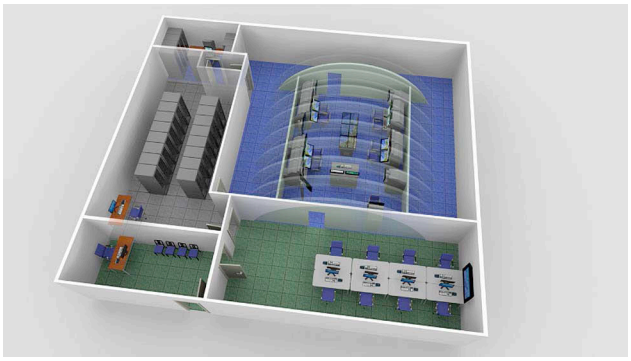
Construction at Mawson Lakes began on 27 July 2015 and is expected to be complete in November. An expanded second phase with a secure area is scheduled to open in the third quarter of 2016.

Raydon Gates, chief executive of Lockheed Martin Australia & New Zealand, said "A submarine's combat system is essentially the eyes, ears and sword of the boat. A submarine's tactical effectiveness depends on a fully-integrated suite of the best technologies from Australia and around the world. The ability to seamlessly integrate the best sensors, sonar, radar, navigation, imagery systems and weapons will give Australia's future submarine the tactical advantage it needs — and that is what Lockheed Martin Australia will deliver."

The laboratory includes a reconfigurable submarine command centre to test and validate the Royal Australian Navy's concept of operations in a simulated operational environment. The lab will feature advanced computer processing with reconfigurable hardware.

Establishing a submarine combat system laboratory in parallel with early stages of submarine design leverages a key lesson learned from the success of the US Navy's Virginia-class submarine program.

The laboratory capitalises on Lockheed Martin's heritage of more than 40 years of demonstrated submarine combat systems integration methodology on submarines for more than seven nations. Gates added that the lab would provide Lockheed Martin with the ability to be involved in every step of the process, reduce development costs and ensure continued interoperability.



An impression of Lockheed Martin's new combat system laboratory
(Image courtesy Lockheed Martin)

Release of ShipConstructor 2016 R1.1

With the release of ShipConstructor 2016 R1.1, SSI has provided additional enhancement for the offshore rig construction market, particularly with regard to weld management. These new features will benefit all shipbuilders, but especially those wishing to expand into the offshore sector.

ShipConstructor 2016 R1.1 is particularly geared towards early adopters of ShipConstructor's latest productivity-enhancing capabilities; the predominant portion of new features are focused on ShipConstructor Subscription Advantage Pack clients.

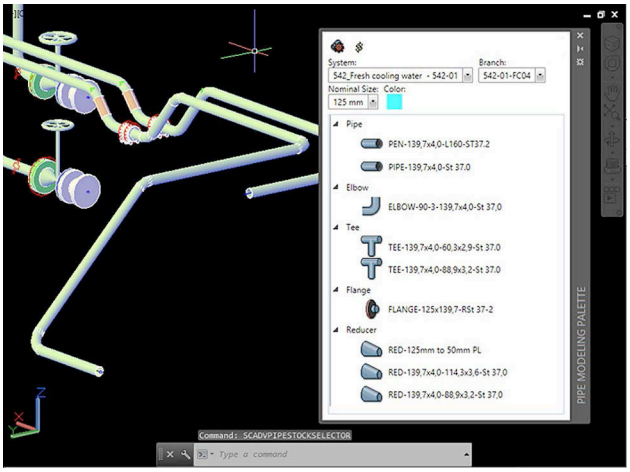
Enhanced Weld Functionality

Clients are increasingly wishing to diversify into oil rig construction. To remain competitive, they require constant

innovation and embrace early adoption of software advancements. Therefore, SSI continues to enhance ShipConstructor's innovative Weld Management product improving the ability to more efficiently model several common situations in rig building, such as welding two sides of the same part to create structural pipes. UDA strings for weld objects and other innovative features have also been incorporated into an updated and modernised Weld Management Palette interface.

Efficient Pipe Modelling Workflow

Efficient pipe modelling is important in both ship and offshore construction, so with this release, SSI Subscription Advantage clients will now be able to get a technical preview of a new Pipe Modelling Tool Palette which enables a more streamlined workflow.



A screen shot of the pipe modelling tool
(Image courtesy SSI)

More Parts, More Options

In every engineering discipline, workflows are continually analysed by SSI experts in consultation with clients around the world to assess the needs of the marine construction industry. Based on this analysis, SSI has created a new customisable plate part in ShipConstructor 2016 R1.1. This new part enhances quality and efficiency by allowing junior designers to pick from catalogues created by more experienced members of the team. ShipConstructor also now has bevel standards for plate parts that are corrugated to prevent costly manual effort in production.

Retrieve Models Ten Times Faster

Perhaps most eye-catching of all is the new ability to MLink Navisworks NWC files utilizing AutoCAD 2016's new feature to attach Coordination Models. Now users will be able to get a visual reference for equipment and structural placement over ten times faster than before. This feature is not just for visualisation; you can interact with Coordination Models as reference geometry as well.

Visualise an Entire Ship Model within ShipConstructor

The amount of information which can be loaded via Coordination Models is enormous compared to traditional MLinks; now you can visualise an entire ship model within ShipConstructor.

To find out more visit the SSI website.

BMT Launches SMART^{POWER} Torque Meter

In September, BMT SMART Ltd (BMT), a subsidiary of BMT Group, announced the launch of its new, highly-accurate and cost-effective SMART^{POWER} Torque Meter, as part of its Fleet Vessel Performance Management (FVPM) suite of products.

BMT's SMART^{POWER} Torque Meter is a dedicated measurement tool specifically designed for the maritime sector, to provide a highly-accurate digital output for torque, speed, power, running hours and total energy. In addition, the system can provide thrust and dynamic data, which BMT SMART software can utilise to analyse the condition of the main engine, propeller and the gearbox.

The system has been developed in partnership with Datum Electronics Ltd, a torque and shaft power measurement specialist with over 25 years of experience working across different industries, including navies, in the development of torsion measurement equipment.

Sebastian Sjöberg, Sales and Business Development Manager at BMT SMART explained "Torque meters are a key part of vessel performance management. However, the majority of products which are currently available on the market can only provide average data. SMART^{POWER} can provide dynamic data which enables us to take condition monitoring to a completely new level."

Peter Mantel, Managing Director of BMT SMART commented "A Torque meter is the key building block of performance management on board and, by working with shipyards to install SMART^{POWER}, at the building stage; we are committed to working closely with owners to manage the performance of their vessels right throughout their lifecycle. With the support of our global network of service partners, we can provide customers with local expertise and knowledge allowing for quick and easy installation and ongoing support."

Wärtsilä 31 Engines Selected for State-of-the-art Icebreaker

The recently introduced Wärtsilä 31 engine, which has been acknowledged by Guinness World Records as being the world's most-efficient four-stroke diesel engine, has been selected to power a state-of-the-art new-generation icebreaker currently under construction at the PJSC Vyborg Shipyard. The ship is being built on behalf of FSUE Atomflot, the enterprise of ROSATOM, the Russian State Corporation for Atomic Energy. The order was signed in September.

When delivered, the icebreaker will serve the Yamal LNG project in Sabetta, located northeast of the Yamal peninsular in Russia. The project is one of the largest industrial undertakings in the Arctic. Fuel efficiency and reliability were the two major deciding factors behind the choice of the Wärtsilä 31 engine. Other key considerations in the decision process were the engine's operational flexibility and its outstanding performance in extreme environmental conditions. The new vessel will operate in temperatures as low as minus 50°C.

The new-generation icebreaker *Aker ARC 124* will feature three 8-cylinder Wärtsilä 31 engines. The installation will

also include Wärtsilä's online monitoring of the engines, thereby enabling their operating condition to be closely followed remotely. An additional characteristic of the newly introduced vessel is that it will feature a totally new approach to maintenance. The first major service required by the Wärtsilä 31 comes only after 8000 running hours (compared to 2000 running hours for engines of a similar class), thus making the Wärtsilä 31 a clear leader in this field. This dramatic improvement reduces maintenance costs to a previously-unattainably low level, as well as greatly increasing the vessel's uptime availability.

"When the Wärtsilä 31 engine was introduced in June, a new approach to marine power generation was launched. By combining a drastic reduction in fuel consumption, increased power output, and a four-fold extension of normal maintenance intervals, our customers now have the chance to redefine how they operate their vessels to a new level of competitiveness. FSUE Atomflot's selection of the Wärtsilä 31 engine after such a short time following its introduction, confirms the value that this engine brings to the market," said Roger Holm, Senior Vice President, Engines, Wärtsilä Marine Solutions.

"We are confident that this project will be a success because of Wärtsilä's credibility in the industry, and the positive experience from our long-established partnership with this solutions provider. High vessel availability and fuel efficiency are the key winning factors for any ship owner. The Wärtsilä 31 engines will facilitate a significant improvement in vessel operations, making it extremely competitive on the market. This new icebreaker, powered by Wärtsilä 31 engines, will be the most technologically-advanced ship of its kind in the whole world," noted FSUE Atomflot First Deputy Director General – Chief Engineer, Mustafa Kashka.

"We are extremely proud to have the opportunity to realise a project involving the newest and most modern domestic icebreaker. This vessel harmoniously combines the operating flexibility and efficiency of the power plant with high safety standards and good ergonomics of the ship's equipment. Despite the fact that the Vyborg shipyard has already had orders for six icebreakers, we are confident that this icebreaker, *Aker ARC 124* will rightly take its place among the most efficient modern domestic vessels operating in Arctic waters," says Alexander Solovyev, General Director of PJSC Vyborg Shipyard.

The Wärtsilä 31 engine

The Wärtsilä 31 is the first of a new generation of medium-speed engines, designed to set a new benchmark in efficiency and overall emissions performance. It is available in 8 to 16 cylinder configurations and has a power output ranging from 4.2 to 9.8 MW, at 720 and 750 rpm. This four-stroke engine has the best fuel economy of any engine in its class. At the same time, it maintains outstanding performance across the complete operating range. Its modular design enables a significant reduction in maintenance time and costs, thereby improving power availability and reducing the need for parts.

The new Wärtsilä 31 engine will power the icebreaker currently under construction at the PJSC Vyborg Shipyard (Image courtesy Wärtsilä)

Neptune Clipper, one of two fast ferries delivered in October by Incat Tasmania to Thames Clippers, London, during trials in Tasmania (Photo courtesy Incat Tasmania)

VALE

Jim Mayson

It is with sadness that *The ANA* records the passing of James Hillier Mayson on 8 August 2015 on the Gold Coast in Queensland at the age of 95.

Born on 1 October 1919, Jim started work at HMA Naval Dockyard Garden Island in 1936 as a shipwright apprentice. On completion of his apprenticeship he was selected for training in the drawing office—then located on the top floor of the main building under the clock tower. Travel to Garden Island in those days was by ferry from Circular Quay. Later a cofferdam and road were built between the Island and Wolloomooloo, and the Captain Cook Dock was built, forming a permanent link to the mainland.

Jim was the first Garden Island apprentice to undergo training at Vickers on Cockatoo Island. He worked in the shipyard on rivetted ships and then later as an overseer with the General Overseer and Superintendent of Inspections' organisation.

In those days, the highest technical and engineering qualification was obtained from Sydney Technical College, and Jim graduated from there with a diploma in naval architecture. Soon after graduation, he was posted to the Ministry of Defence in the UK as the one of the first Australian Construction Liaison Officers.

Returning to Australia, he became Senior Naval Architect at Williamstown Dockyard in Melbourne, where he became involved in the construction, fitting out and trials of HMA Ships *Vendetta, Yarra* and *Derwent*, and the repair, refit and conversion of other ships.

During the 1960s he was engaged in the re-design of the destroyer escorts for the construction of HMA Ships *Swan* and *Torrens*, the Attack-class patrol boats, the destroyer tender HMAS *Stalwart,* the early development work for the light destroyer (DDL), the fast combat support ship (AOE), the oceanographic ship HMAS *Cook* and many support craft.

In 1970 he became the first Director of Naval Ship Production, and then Director General Naval Production from 1976 to 1978. During this period he took part in two missions overseas, leading to the placing of orders for the RAN's last two Oberon-class submarines, HMA Ships *Orion* and *Otama.* This was followed by involvement in the procurement of the design and production documentation necessary for calling tenders and then placing the contract for the amphibious heavy-lift ship, HMAS *Tobruk.*

Jim Mayson

He then became Director General Naval Design, the first Australian-born holder of that position, where he supervised a civilian and uniformed staff of about 400. Reminiscing on retirement about how naval ship design had changed over the years, he said "In the early days we were doing a lot more in-house ship design and ship construction work. But ship design in more-recent years has become more complex. One has to take into account, for example, more-complex ship's weapons systems, communications systems and propulsion systems than in the past".

On retirement in 1981, a senior naval officers' farewell was held for Jim at HMAS *Harman* in Canberra, where he was presented with a model of the Attack-class patrol boats by Rear Admiral Fred Lynam. Jim moved to a property which he purchased at Dalton, near Gunning, NSW, where he grazed sheep and did some overseas travelling.

In recent years Jim lived at Runaway Bay in Queensland. He is survived by his son Douglas, daughter Beth, four grandchildren and three great grandchildren.

Navy News, 28 August 1981
John Jeremy
Phil Helmore

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on Wednesday 16 September 2015 by teleconference based in Sydney.

Some of the more significant matters discussed during the meeting were:

Possible Future Division Activities

Further to the discussion at the June meeting, Council considered the President's assessment of the priorities to be given to various activities and agreed to discuss this matter further at the December Council meeting.

Submission to Senate Inquiry

Council noted that the Senate Foreign Affairs Defence and Trade References Committee was conducting an inquiry into the Capability of Defence's Physical Sciences and Engineering Workforce. Given that this subject covers the work of many of the Division's members and the outcome of the inquiry may substantially impact on the professional

work of those members, Council decided in-principle to make a submission. Following consultation with and input from interested affected members, the Division's submission was subsequently prepared and then lodged on 26 October. It can be downloaded as Submission No. 27 from http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Foreign_Affairs_Defence_and_Trade/Defence_PSE_Workforce/Submissions.

PACIFIC 2015 IMC

Council received a report from the Chairman of the Organising Committee indicating that all was in readiness for a highly successful conference on 6–8 October. Subsequent reports from attendees have been highly favourable, notwithstanding the problems associated with using a temporary venue.

Walter Atkinson Award for 2015

Council agreed with the recommendation of the assessment committee that the Award should go to Dr Roger Neill of DSTG for his paper *Preliminary Analysis of Imagery Data arising from the 2014 Internal Investigation of HMAS AE2* which was presented to the September 2014 meeting of the Victorian Section.

Next Meeting of Council

The next meeting of the Australian Division Council will be held on Thursday 3 December, tentatively at 1200 Western Standard Time (1500 Eastern).

Rob Gehling
Secretary

Walter Atkinson Award 2015

The Walter Atkinson Award was established in 1971 to commemorate the life, work and service of Walter Atkinson as a founding member to the Australian Branch (now the Australian Division) of RINA. The Award has been presented from time to time since its introduction. Originally the Award was to:

> *stimulate increased interest in the preparation, and to raise the standard, of technical papers presented by members to the institution.*

In 2002 the RINA Australian Division Council broadened the eligibility for the Award, while adhering as far as possible to its original intent, by changing the object to:

> *stimulate increased interest in the preparation and to raise the standard of technical papers presented to the naval architecture community in Australia*.

and broadened the eligibility to:

> *The nomination may be for a presentation which includes a written technical paper, or for a technical published paper, and it must be more than a promotional presentation. The paper must be first presented at a maritime conference or RINA meeting within Australia, or first published in a maritime journal within Australia, during the current year. All authors are eligible.*

Using this eligibility criterion this Award was presented once again in 2013 and 2014, after having lapsed for several years.

The award for 2015 went to Dr Roger Neill of the Defence Science and Technology Group for his paper on *Preliminary Analysis of Imagery Data arising from the 2014 Internal Investigation of HMAS AE2*.

The award was presented to Roger at the Cocktail reception for the Pacific 2015 International Maritime Conference on the evening of 7 October by the Chief Executive of RINA, Trevor Blakeley.

Trevor Blakeley presenting the Walter Atkinson Award for 2015 to Roger Neill at the Cocktail Reception for the Pacific 2015 IMC (Photo John Jeremy)

Changed contact Details?

Have you changed your contact details within the last three months? If so, then now would be a good time to advise RINA of the change, so that you don't miss out on any of the Head Office publications, *The Australian Naval Architect*, or Section notices.

Please advise RINA London, *and* the Australian Division, *and* your local section:

RINA London		hq@rina.org.uk
Aust. Division		rina.austdiv@optusnet.com.au
Section	ACT	rinaact@gmail.com
	NSW	rinansw@gmail.com
	Qld	m-dever@hotmail.com
	SA/NT	danielle.hodge@defence.gov.au
	Tas	mfsymes@amc.edu.au
	Vic	andrew.mickan@dsto.defence.gov.au
	WA	rina.westaus@gmail.com

Phil Helmore

International Ship and Offshore Structures Congress

The 19th International Ship and Offshore Structures Congress (ISSC) met in Cascais, Portugal between 7 and 10 September 2015. The overall aim of the congress is to facilitate the evaluation and dissemination of results from recent investigations, to make recommendations for standard design procedures and criteria, to discuss research in progress and planned, to identify areas requiring further research, and to encourage international collaboration in furthering these aims. Structures of interest to the ISSC include ship and other marine structures used for transportation, exploration and exploitation of resources in and under the oceans.

Attendance at the ISSC is by invitation only to those who are in a position to contribute to the aims of the congress through active research in the domain. Australia was well represented at this year's congress and now has six members of the ISSC working in various committees for the next congress to be held in Belgium/Holland in 2018. The members and committees are:

Dr Stuart Cannon, DST Group — Special Craft Committee and Australian Corresponding member

Dr Roberto Ojeda, AMC/University of Tasmania — Ultimate Strength Committee

Dr Shuhong Chai, AMC/University of Tasmania — Pipelines and Risers Committee

Prof Alexander Babanin, Swinburne University of Technology — Environment Committee

Dr Stephan Van Duin, DMTC/University of Wollongong — Materials and Fabrication Committee

Australian ISSC Members — (L to R) Roberto Ojeda, Stuart Cannon, Shuhong Chai, Stephan Van Duin and Alex Babanin (absent Seref Aksu)
(Photo courtesy Stuart Cannon)

Dr Seref Aksu, DST Group — Structural Longevity Committee

Further details of the congress can be found at www.issc2015.org. This site also enables you to download the reports of the previous congress and will ultimately house the current reports. The committee reports are a valuable source of information for students and practitioners in ship and offshore structures. If anyone is interested in participating in the next congress then contact Stuart Cannon for more information.

Stuart Cannon

THE INTERNET

Webcasts of NSW Section Technical Presentations

Engineers Australia records selected technical presentations made to RINA (NSW Section) and IMarEST (Sydney Branch) for webcasting. The recordings are placed on the Engineers Australia website, usually within a few days of the presentation.

All of the recorded webcasts up to 30 September 2014, together with hotlinks to each one, are listed at

www.rina.org.uk/NSWwebcasts.html.

On 1 October 2014, Engineers Australia started using a new system for recording presentations, using three cameras and a hand-held microphone, with an audio technician in attendance. Webcasts are placed on the Engineering on Line (EoL) website at www.engineeringonline.com. The first presentation to be recorded with this new system was Graham Taylor's presentation on *LNG — The New Marine Fuel?* on 1 October, and the presentation is up on the EoL website at www.engineeringonline.com/video/xjkrsdrf/lng-the-new-marine-fuel. Details of how to access this recording were given in the February 2015 issue of The Australian Naval Architect.

However, Engineers Australia has now discontinued using the new recording method and the EoL website for regular monthly presentations, and have resumed using Mediavisionz while considering options for future recordings.

In 2015, only one recording was made, and the link to the webcast made on 1 April 2015 is shown on the NSWwebcasts website.

For future recordings, watch this space!

Phil Helmore

NAVAL ARCHITECTS ON THE MOVE

The recent moves of which we are aware are as follows:

William Birdsall has moved on within Austal Ships and has taken up the position of Engineering Material Planner in Fremantle.

Greg Carmody (formerly Laanemaa) moved on from motor yacht *Honey Bear* in 2010 and, after some time on motor yachts *Latitude, Le Yana* and *Ellicha*, in 2011 took up a position as a naval architect with Azure Naval Architects in Haarlem, The Netherlands.

John Colquhoun has retired from the his position as Executive Director of the recently-formed Naval Technical Bureau (formerly Directorate of Navy Platform Systems) and has home improvements in Canberra and overseas travel on the agenda.

Simon Crook moved on from Marshall Lethlean in 2008 and, after some time at Synertec, GP Graders and SCdraft, in 2013 took up the position of Senior Draftsman and CAD System Manager at ThyssenKrupp Marine Systems Australia in Melbourne.

Peter Crosby has moved on within ASC and has been seconded as Program Planner to SEA 1000, the Future Submarine Project, in Adelaide.

Rowan Curtis has moved on from Forgacs and is now consulting as Curtis Consulting in Newcastle.

Gordon Danton has moved on within ResMed and has taken up the position of Global Product Manager in Sydney.

James Davies moved on from Aker Kvaerner in 2002 and, after some time at McDermott International, Technip, ARV Offshore, Independent Offshore Solutions and Dawn Engineering and Construction, has taken up the position of Construction Manager and Technical Adviser at Crowley Solutions in Houston, TX, USA.

Steve Davies has moved on within WorleyParsons and has taken up the position of Global Marketing Director in Sydney.

Eric de Brey moved on from Austal Ships in 2012 and, after some time at Intecsea, is now consulting in Perth.

Katrina de Graaf moved on from the Defence Materiel Organisation in 2010 and completed her PhD on the pressure field and bubble dynamics of a seismic airgun at Australian Maritime College in 2014. She has now taken up the position of Post-doctoral Research Fellow at the Australian Maritime College in Launceston.

Luke Dodds moved on from Lawson and Treloar in 2004 and, after some time at J. Ray McDermott, Fluor, Saipem and the Gorgon Upstream Joint Venture, in 2013 took up the position of Installation Engineer with Woodside Energy in Perth.

John Donovan has moved on from Sigma Offshore and, after a short time at Houlder, has taken up the position of Lead Structural Engineer with London Marine Consultants in London, UK.

Jonathan Duffy has moved on within the Australian Maritime College and has added the position of Deputy Director (Research) to his portfolio in Launceston.

Ray Duggan has retired from his position as Director of Project SEA 1179/1180 in the recently-formed Capability Acquisition and Sustainment Group (formerly the Defence Materiel Organisation) and has home improvements in Canberra and a break, after a long career with Defence, on the agenda.

Paul Duncan has moved on from INTECSEA and has taken up the position of Engineering Manager with Bumi Armada in Kuala Lumpur, Malaysia.

Noel Dunstan moved on from Wärtsilä in 2008 and, after three years at Ulstein Design and Solutions, took up the position of Senior Engineer Hydrodynamics at STX OSV in Ålesund, Norway.

Gooitzen Eggink moved on from Formation Design Systems in 2008 and returned to The Netherlands, where he spent three years with HR Woodcomfort, then four years studying medicine at the Rijksuniversiteit in Groningen, and has now taken up the position of Semi-physician in Geriatrics with at Medisch Centrum in Leeuwarden.

Jareth Ekin has moved on from Austal Ships and has taken up the position of Senior Naval Architect with Halcyon in Perth.

David Ellery moved on from Austal Ships in 2013 and, after a short time at ONA Group, has returned to Austal Ships as a naval architect in Fremantle.

Clive Evans moved on from Lightning Naval Architecture in 2014 and, after a year at QinetiQ at Haslar, UK, has taken up the position of Senior Naval Architect with Spiral Marine Design in Southampton, UK.

Mark Evans moved on from London Offshore Consultants in 2008 and took up the position of Principal Naval Architect/ Senior Project Engineer with Crondall Energy Consultants in Perth.

Allan Falconer moved on from Qatargas in 2006 and, after some time at BP Shipping and Det Norske Veritas, has taken up the position of Lead Technical Integrity Engineer with INPEX in Perth.

Geoffrey Fawcett has moved on from American Bureau of Shipping and has taken up the position of Marine and Technical Manager with Svitzer Australasia in Sydney.

Lee Fennell moved on from SWG Offshore in 2010 and, after some time at Cube Offshore, JP Kenny and CEONA, is now consulting as a subsea installation engineer in London, UK.

James Fenning has moved on with the change of company name from SapuraClough Offshore to SapuraKencana Australia, and has taken up the position of Project Manager in Perth.

Liam Finegan has moved on from ASO Marine Consultants and is now consulting as a naval architect in Sydney.

Nigel Finnerty moved on from consulting in 2007 and took up a position with Rio Tinto Alcan, where he is now Manager Operational Services in Invercargill, New Zealand.

David Firth has moved on and has taken up the position of Engineering Manager with Chemstore International Group in Sydney/Parkes.

Mike Fitzpatrick has moved on within Robert Allan Ltd and has taken up the position of Vice-President Projects in Vancouver, Canada.

Steve Fitzsimmons moved on from Technip in 2011 and, after a year at Heerema Marine Contractors, has taken up the position of Senior Engineer at Neptune Marine Services in Perth.

Andrew Forbes moved on from Austal Image in 2006 and, after some time at Hanseatic Marine, WMD and Leighton Contractors, has taken up the position of Manager Project Development (Marine) with Cape Preston Port Company in Perth.

Alan Goddard has taken up the position of Senior Composite Engineer at Ellis Engineered in Melbourne.

Andrew Gordon moved on from Tribon Solutions in 2000 and, after some time at Atlantec Enterprise Solutions, AVECS and SpecTec, in 2008 took up the position of Regional Manager Marine with AVEVA in Hamburg, Germany.

Kristoffer Grande moved on from German Frers in 2006 and, after some time with Forgacs Engineering and Serco Systems, has taken up the position of Consultant with Jacobs Australia in Canberra.

Geordie Grant, in addition to his posting to the Defence Materiel Organisation, is undertaking a Masters of Maritime Engineering (Naval Engineering) degree through the Australian Maritime College.

Gillian Gray moved on from Austal Ships in 2007 and, in 2009, commenced consulting as Director and Principal Naval Architect of Gray Naval Architecture in Bideford, Devon, UK.

Dean Gregorevic continues in his position as Operations Engineer with McDermott International in Perth.

Pranjal Gupta has moved on from Euro Solar and has taken up the position of Sales Team Lead with Alba International in Sydney.

Ben Healy moved on from Sinclair Knight Merz in 2007 and, after some time at TEK-Ocean Energy Services, in 2011 took up the position of Managing Director with Thrust Maritime in Melbourne.

Holley Lees moved on from INTEC Engineering Group in 2005 and took up the position of Project Engineer with DOF Subsea, and has now also taken up the position of Engineer with Tasmanian Parks and Wildlife in Hobart.

Cameron Lowry moved on from Alan R. Cameron in 2004 and, after some time at Grandweld Shipyards and Miclyn Express Offshore, in 2014 took up the position of Project Manager Shell *Prelude* Infield Support Vessel with KT Maritime Services Australia in Perth.

Bruce McNeice has moved on within the Department of Defence and has recently taken up the position of Executive Director with the newly-formed Naval Technical Bureau in Canberra.

Martin Mok moved on from Roc Oil in 2004 and, after some time at Bridgeport Energy, Oil Search and Lightning Naval Architecture, has taken up a position as a naval architect with Shearforce Maritime Services in Sydney.

Vesna Moretti has moved on from Wood Group Kenny and has taken up the position of Senior Naval Architect with Crondall Energy in Perth.

Cameron Nilsson-Linne has moved on from Jeyco and is now consulting in Perth.

John Polmear has moved on from Austal Ships and has taken up the position of Naval Architect/Project Engineer with Viking SeaTech in Perth.

James Rintoul moved on from @www in 2000 and, after some time at The Currency and then back at @www, in 2013 took up a position with DT in Sydney, where he is now the Technical Director.

Anton Schmieman has moved on within Austal Ships and has taken up the position of Technical Sales Manager in Mobile, AL, USA.

Robert Skerman has moved on from consulting and has taken up a position as a naval architect with Jacobs Australia in Canberra, working on the SEA5000 (Australia's future frigate) Project.

Samantha Tait has moved on from Frazer-Nash Consultancy and has started her own consultancy, Tusk Engineering, in Melbourne.

Elliot Thompson has moved on from the recently-formed Naval Technical Bureau (formerly Directorate of Navy Platform Systems) and has taken up a position as a trainee surveyor with DNV GL in Sydney.

Mike Tweedie has moved on from the Department for Transport, Energy and Infrastructure and is now consulting as Tweedmarine in Risdon Park, SA.

Jan Verdaasdonk has moved on from QinetiQ Australia and has taken up the position of Director of Business Development with RSC Bio Solutions in Charlotte, NC, USA.

Mark Williamson continues in the position of Managing Director with Southport Custom Yachts in Southport, Qld.

Thomas van Peteghem, a recent graduate of UNSW Australia, has moved on from Van Peteghem Lauriot-Prévost (VPLP) and has commenced a master's degree in Management of Innovations in Paris. VPLP has designed some of the world's most innovative racing boats, and their designs presently hold many of the World Speed Sailing records —see https://en.wikipedia.org/wiki/VPLP for details.

Konrad Zurcher has submitted his PhD dissertation at the Australian Maritime College and has taken up the position of Autonomous Underwater Vehicle Engineer for the Antarctic Gateway Partnership project at AMC in Launceston. The main objectives of the AGP project (see www.imas.utas.edu.au/antarctic-gateway-partnership) are to develop a new AUV/ROV technology hub at AMC and to specify, tender, commission, and operate a new long-range AUV for Antarctic and under-ice studies.

This column is intended to keep everyone (and, in particular, the friends you only see occasionally) updated on where you have moved to. It consequently relies on input from everyone. Please advise the editors when you up-anchor and move on to bigger, better or brighter things, or if you know of a move anyone else has made in the last three months. It would also help if you would advise Robin Gehling when your mailing address changes to reduce the number of copies of *The Australian Naval Architect* emulating boomerangs.

Phil Helmore
Martin Grimm

FROM THE ARCHIVES

HMAS SYDNEY
1983–2015

John Jeremy

On 7 November 2015 HMAS *Sydney* was decommissioned at Garden Island in Sydney after 32 years of service in the RAN. HMAS *Sydney* was a guided missile frigate (FFG), one of six to serve in the RAN, four of which were built in the United States (*Adelaide*, *Canberra*, *Sydney* and *Darwin*) and two of which were built at Williamstown in Australia (*Melbourne* and *Newcastle*).

In 1973 the Australian Government cancelled the program to construct three light destroyers (DDL) at Williamstown Naval Dockyard in Victoria. The classification 'light destroyer' was really inappropriate and an accident of history — by the time of cancellation the original design for what had been effectively a large OPV had grown into a large, very capable and rather expensive destroyer designed specifically for the RAN. The cost of developing the DDL had prompted naval staff advice that the US Navy's guided missile frigate (FFG) design presented a viable and better-value alternative as the weapons fit in the two ships was almost the same. The DDL was cancelled and, following a further review of the options, the FFG was selected for the RAN.

The FFG was developed from a feasibility study initiated in September 1970 by US Navy Chief of Naval Operations, Admiral Elmo Zumwalt, for a destroyer-type ship which could be optimised for essentially one mission. The ship, originally designated patrol frigate (PF 109 class), became the Oliver Hazard Perry (FFG 7) class frigate. From the outset, the ship was planned to be simple and inexpensive — an austere destroyer intended as a transatlantic escort for fast convoys or a static picket for ten days about one thousand miles from home base. The austerity extended to providing only one propeller and the ship was provided with two podded retractable propulsors as 'get-home' insurance, capable of driving the ship at five to six knots in a calm sea.

The detail design of the FFG was undertaken by Gibbs & Cox and the lead ship was ordered from Bath Iron Works in October 1973. The class was initially intended to comprise 50 ships but, ultimately, 71 were built, 51 for the US Navy, six for Australia, eight for Taiwan, and six for Spain. Fifty five were built in the US, including the first four Australian ships. Despite all the compromises made in their design, and the relatively austere standards accepted to reduce cost, the FFG was to prove a very robust and successful ship.

The ships were built in the US by two shipbuilders in three yards. Bath Iron Works in Bath, Maine, and Todd Shipyards Corporation in Seattle and Los Angeles. The orders for these ships were a lifesaver for Todd Shipyards which had a long history of building warships for the USN but had not done so for some time and had suffered big losses on some merchant shipbuilding contracts in the early 1970s.

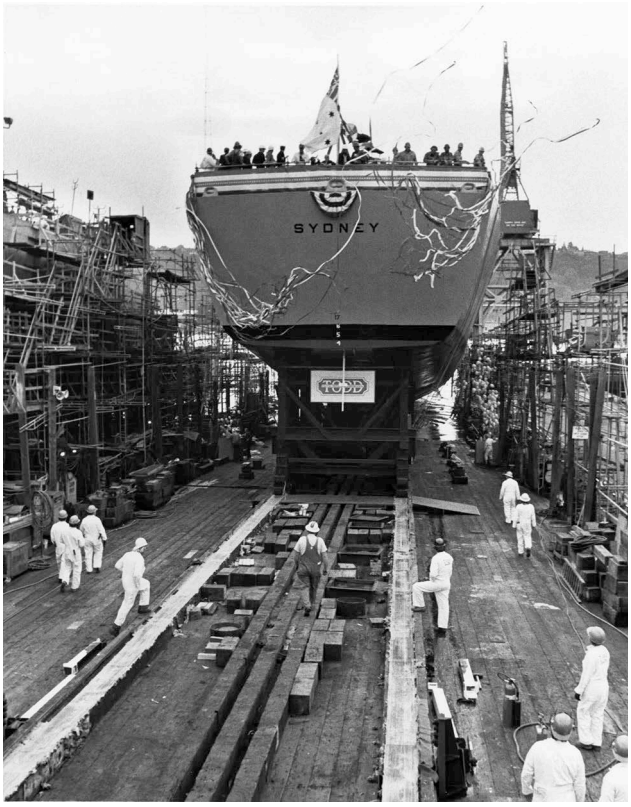
The first two Australian ships were ordered from the US in 1976 — US Navy hull numbers FFG 17 and 18 were allocated to Australia — and the ships were ordered from

HMAS *Sydney* on the slipway in Seattle (middle). There are five FFGs at various stages of construction in this photograph (RAN Historical Collection)

Todd Seattle. Todd's first FFG was USS *Duncan*, built at Seattle, but she was the second to complete with the first from the Los Angeles yard beating her into service. *Duncan* was also the shortest lived of the class, serving for only about 15 years. With a lack of recent warship building experience, Todd had difficulty in attracting skilled labour, and the quality of ships out of Seattle was subject to some criticism, including by Australian Navy representatives in the yard. *Adelaide* and *Canberra* were the second and third FFGs built at Todd Seattle. The RAN's third ship, *Sydney*, US Navy hull number FFG 35, was ordered in 1977 and a fourth, *Darwin* (USN FFG 44) was added later. The benefit of Todd's increasing experience in building the class was evident in these later ships.

The Australian ships differed in design slightly as the FFG program was developed. *Adelaide* was built to the Flight I design, whilst *Canberra* and *Sydney* were the first and last ships built to the Flight II design respectively. *Darwin* was built to the Flight III design, which had an enlarged flight deck and was slightly longer. The FFGs were the first gas-turbine powered ships in the RAN.

The construction of the ships at Todd Seattle was very conventional for the time. There was no construction of extensively outfitted modules as we would expect today and see in the construction of the new air-warfare destroyers. Any visitor to the yard would have been struck by the intense activity with ships everywhere. The ships were built on inclined slipways and, unusually, launched bow first. This was done at the Seattle yard because of local conditions which could result in damage to propellers and rudders if the ships were launched conventionally stern first.



HMAS *Sydney* entering the water at her launching in Seattle on 26 September 1980
(RAN Historical Collection)

HMAS *Sydney*, about 70% complete, in the fitting-out basin at Todd Shipyard Corporation's Seattle shipyard
(RAN Historical Collection)

HMAS *Sydney* was laid down on 16 January 1980, launched on 26 September 1980 and was commissioned on 29 January 1983. During her long and very active life, the ship was extensively modified on two occasions. The first major change was to extend the ship's stern to enlarge her flight deck to enable her to operate Sea Hawk helicopters. This work was done at Garden Island in Sydney. The second modification was by far the most extensive. HMAS *Sydney* was the first of four RAN FFGs to undergo the FFG upgrade program which included improvements to the combat system, weapons and sonar and, for *Sydney* and *Darwin*, a life extension. The FFG upgrade program had its problems and ran considerably behind schedule but, on completion, resulted in the most effective and versatile FFGs in the world. HMAS *Sydney* began her upgrade at Garden Island in Sydney on 22 September 2003. She returned to sea for trials on 9 December 2004 but the upgrade was not final completed until 28 April 2006.

HMAS *Sydney* has served Australia well during her decades of service. A fifth HMAS *Sydney* is under construction — the third of the air-warfare destroyers being built in Adelaide — ensuring that the famous name will continue to serve in the RAN for decades to come.

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HMAS *Sydney* in the Captain Cook Dock at Garden Island in Sydney during her refit when her stern was extended and flight deck modified
(RAN Historical Collection)

HMAS *Sydney* firing a Standard missile (SM2) on the Pacific Missile Range off Hawaii in 2011 after her capability upgrade
(RAN photograph)

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